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THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY,

INCLUDING
ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND
CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY
PRIDEAUX JOHN SELBY, Esq., F.L.S.,
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AND
WILLIAM FRANCIS, Ph.D., F.L.S.

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**VOL. XIII.—THIRD SERIES.**  
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1864.

"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportionone, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exulta; malè doctis et barbaris semper inimica fuit."—
LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.



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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

"..... per litora spargite muscum,
Naiades, et circum vitreos considite fontes :
Follice virgineo teneros hic carpite flores :
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas ;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Dem pelagi, et pingui conchyliis succo."
N. Parthenii Giannettassi Bol. 1.

No. 73. JANUARY 1864.

I.—On the Menispermaceæ.

By JOHN MIERS, F.R.S., F.L.S. &c.

IN 1851 (Ann. Nat. Hist. ser. 2. vii. 83) an outline was given of the results of a careful examination of the *Menispermaceæ*, which I had completed three years previously: the object of that sketch was to call the attention of botanists to the subject, and to solicit the aid of better materials for the elucidation of some of the genera, which I had not been able to examine. During the long interval since elapsed, the addition to our knowledge on this subject has been small; and this is one reason why the idea of making a complete monograph of this little-known extensive family, as at first contemplated, has been renounced. But as the principal facts relating to this inquiry remain yet unpublished, it may be useful to give in succession some further details of my previous investigations; and with this view I now proceed to offer some prefatory remarks on the general structure of the order.

The *Menispermaceæ* are generally marked by an external aspect by which, even in herbaria, they are instantly recognized. With rare exceptions, they are all scandent plants, with twining stems, which are often of immense length, presenting a wood of considerable toughness: this has a coarse porous structure formed of radiating segments connected together by walls of dense ligneous tissue, thus bearing some analogy to the *Lardisabalaceæ*,

Ann. & Mag. N. Hist. Ser. 3. Vol. xiii.

1

Nepenthaceæ, Aristolochiaceæ, Piperaceæ. &c. On this account, many years ago, Professor Lindley separated these families from Exogens, under the name of Homogens, the leading feature of which was then believed to be, that, "instead of their wood being formed by zone after zone, season after season, as is the case in the great mass of Exogens, they never have more than one zone of woody matter, to whatever age they may have arrived." This conclusion was, however, soon abandoned, as the existence of more zones than one was fully proved. I have frequently seen several annular rings in the stems of *Menispermaceæ*; and Gardner found one, in Ceylon, in which he counted more than forty distinct concentric zones; but such instances are comparatively rare. It would be needless to detail the structure of the wood in this family, as the subject has been ably demonstrated by Decaisne and others, and as there is little novel information to offer respecting it.

The leaves in the plants of this order are constantly alternate, petioled, and always without stipules; but in many cases the petiole, finally deciduous, is articulated upon a prominent pulvinate cup, on the upper margin of which, adjoining the stem, is seen a budlike process, appearing as if a pair of stipules had embraced the cup, and had become agglutinated to it and the stem: this must not be confounded with the gemma of a nascent branch or flower-stem, which in most instances is supra-axillary. In the genus *Antizoma*, the pulvinate process just mentioned, at its articulation with the petiole, is elongated in the form of a spur, so that it bears the appearance of a short spine. The petiole is often much swollen and tortuous at its base, and, being suddenly bent back, it performs the office of a tendril in supporting the young climbing branches. Its insertion into the blade of the leaf is either peltate or palate. In the former case the point of union is never quite central, but always more or less excentric, sometimes approaching the margin, where the leaf is more or less truncated or cordate. The palate insertion, however, is more frequent, when the petiole, at its junction with the midrib, often subtends a considerable angle with the plane of the leaf, and is commonly much swollen at that extremity by an enlargement which the French botanists call a *bourrelet*. The leaves vary greatly in form, substance, and texture, and have generally, but not always, three, five, or more nerves springing from the point of insertion of the petiole: they are generally entire on the margin, but sometimes are sinuous or distinctly lobed, more rarely sinuately dentate, or cleft into palmate segments, or (in *Burasaia*) divided into three sessile leaflets on the summit of a long petiole.

The inflorescence varies in different genera, being chiefly

axillary, with one or several racemes, more or less simple, growing from a point a little above the origin of the petiole: the pedicels are sometimes branched, when the inflorescence becomes somewhat paniculate; at other times the flowers are condensed into globular heads upon the peduncle; sometimes the axillary flowers appear in fascicles of pedicillated single flowers, or are simply umbellate, or in umbels compounded to the second or third degree. I have frequently observed the racemes growing abundantly on the stems devoid of leaves. The flowers are generally furnished with bracts; they are extremely minute, and, though often hairy, are sometimes destitute of pubescence: they are, with very rare exceptions, universally unisexual and dioecious. They are said to be sometimes monœcious; but this appears doubtful. In the two instances recorded by DeCandolle, I found, by an examination of the original specimens, that they were decidedly dioecious. St. Hilaire records the existence of a monœcious species of *Cissampelos* (*C. monoica*): this has not been confirmed by any other observer, and is the only instance on record. I have, however, seen two cases where the flowers are distinctly hermaphrodite, or, rather, polygamous. I have observed, in *Anomospermum*, a solitary ovary in the male flowers in a few instances; and I found it a universal feature in a specimen of *Tiliacora* from the island of Ceylon.

The arrangement of the floral envelopes (sepals) is usually in several ternary imbricated series, gradually decreasing outwards, the two internal whorls being in most instances considerably larger than the others; and they probably constitute the true normal number of six sepals; and all the outer ones, frequently very minute in size, may be considered as bracts. These six sepals, though in æstivation generally in two imbricate series, are fixed in a nearly circular whorl around a small central torus; but sometimes as many as five ternary whorls are seen arranged, one above another, upon a cylindrical gynæcium, as in the *Magnoliaceæ*. The number in each series is generally three, though sometimes four, five, or six occur: in *Anamirta* and *Quinium* we have a pentamerous arrangement; in *Antitaxis* the floral parts are disposed in opposite pairs, while in *Antizoma* we have the remarkable instance of two opposite sepals hooding two petals placed before them: rarely, as in *Rhaptomeris*, owing to the confluence of the margins of its six sepals, the calyx is gamophyllous, being quite tubular and campanulate. In *Synclisia*, according to Mr. Bentham, the sepals are somewhat united at base into a very short tube; while in *Stephania* and *Cyclea*, although the sepals remain distinct, they assume, by their erect position and approximated margins, the semblance of a tube. The æstivation of the sepals, although in most cases imbricate,

is sometimes valvate, as in the cases last mentioned: this occurs in *Tiliacora*, *Abuta*, and *Limacia*. The symmetry in the arrangement of the floral envelopes, though generally similar in both sexes, does not exist in *Cissampelos*, *Cyclea*, *Clypea*, *Antizoma*, and *Stephania*, where, in the female flowers, many of the parts are wanting, being sometimes reduced to a single sepal and only one minute petal, while the male flowers exhibit the usual number of sepals.

The petals, usually six in number, are in the form of small scales or fleshy leaflets originating from the torus. Little notice was taken of them formerly, as they were looked upon as a mere nectary; but they are now universally regarded as real petals, though of minute size; in some few instances they are entirely wanting, as in *Abuta*, *Anelasma*, and *Batschia*: in *Fibraurea* they are apparently deficient, but they are probably confluent with the filaments, seemingly as if wrapped round them: in many of the genera the petals, though quite free, are found, in a similar manner, with their margins involute and embracing the filaments.

The stamens, especially in the male flowers, by their form and position, afford constant and valid characters; they are usually equal in number to the petals, opposite to them, and generally in two distinct approximated whorls. In most instances they are all quite free; but sometimes the three outer stamens are free, while the others are partially monadelphous in the centre; at other times they are all more or less compactly united into a simple central column. They are usually as long as the petals, frequently double their length. The anthers are generally two-lobed, the lobes being often separated by a connective, which is continuous with the filament; sometimes they are combined together without the intervention of any connective, and partially sunk in the apex of the filament, or often approximated and dorsally affixed upon it; generally these lobes open by a longitudinal suture, but they sometimes burst by a transverse, vertical, or oblique fissure. In the *Cissampelos* group, the stamen consists of a single filamentous column supporting a horizontal peltate disk bearing on its margin four, six, eight, or more anther-cells, combined in an annular form, which burst on their outer edge, like the indusium of some ferns. In other cases several anther-cells are combined into a globular mass, and are either sessile on the torus or supported on a central column. In many cases each anther-cell appears bilocellate, owing to a prominent septum that almost or completely divides it. These great varieties in the disposition and structure of the stamens are constant in each genus, and may be trusted as good discriminating characters.

In the female flowers we generally find the same number and disposition of floral envelopes as in the male; and there is sometimes a similar number of sterile stamens around the ovaria, but in most instances they are altogether wanting. In the centre of the flower the torus rises more or less in a cylindrical form, to the sides of which the sterile stamens, when present, are attached; they are generally free from one another, but are more rarely attached at their base by a short ring that surrounds the more elevated gynæcium. This latter, in some few cases, bears on its summit only a single ovary; but most generally it carries three distinct ovaries, occasionally four, five, or six, or rarely as many as twelve, arranged in a single whorl. These ovaries are generally sessile, but are sometimes borne each upon a stipitate support, that lengthens considerably with the growth of the fruit. The ovary is unilocular in every instance that has fallen under my observation, and never contains more than a single ovule—a character which forms a valid line of distinction between this order and the *Lardizabalaceæ*, *Schizandraceæ*, and *Winteraceæ*.

The growth of the ovary and the development of the ovule, together with the changes produced in the structure and form of the fruit, present excellent and constant characters, that have not been sufficiently attended to. St. Hilaire was the first botanist who devoted any consideration to the subject, when, in describing a species of *Cissampelos* (Pl. Us. tab. 35), he gave a detailed account of this growth, from the period of the impregnation of the ovule to the final perfection of the fruit. According to his view, the ovary, by its excentric growth, gradually curves itself round in the form of a horseshoe, until the two sides thus bent round touch one another, when they become agglutinated together (*se soudent*): it thus assumes an ovoid or subglobular form, and the original apex, indicated by the style, is thus approximated to the base, the two being separated by the septum thus formed, which extends far into the cell, and which is generated by the “*deux portions rapprochées et soudées du péricarpe*.” The cell, and consequently the seed, thus assume a corresponding hippocrepical shape.

This view, not altogether correct as far as regards *Cissampelos*, wholly fails to explain the changes attendant on the development of the fruit in other cases. Although the ovule, in an early stage, is simply anatropal and attached to the ventral face, at a point somewhat above its middle from the summit, of a linear placenta on the inner angle of the cell, there is always seen upon the corresponding concave margin of the ovule, below the point of its suspension, a thickened and somewhat curved rib, which is probably the indication of the raphe and chalaza: the

ovule is now partly free from the placentiferous angle of the cell, but most generally it becomes at length adherent to it after the excentric growth and apparent duplicature of the ovary. It is incorrect to say, regarding this development, that the two halves of this curvature are brought together till they unite in order to form the incomplete dissepiment in the manner above described. The circumstance which St. Hilaire mentions as the cause of the metamorphosis appears to me, on the contrary, the result of an agency which he has entirely overlooked, and to this source only the apparent duplicature can be referred. My observations tend to the conclusion that it originates in a peculiar expansion and induration of the placenta within the cavity of the cell, to which cause alone is to be attributed this excentric growth of the ovary; for, in those cases where the placenta does not become expanded, no such duplicature occurs. In the instance of *Cissampelos*, cited by St. Hilaire, it may be seen that the linear placenta first protrudes and extends itself at right angles with the side of the ovary, in the direction of the centre of the cell, and that the growth of the pistil on that side is at the same time arrested, in consequence of which the style and the base of the ovary preserve nearly their original distance, while the growing force is all expended on the opposite or dorsal side, thus producing the hippocrepical appearance described. By observing a section of a half-matured seed of *Cissampelos*, the development of the pseudo-dissepiment may be seen distinctly, when the nourishing vessels belonging to the placenta can be traced in the centre of this line of extension, reaching to its extremity, like an imbedded umbilical cord, which is found in the same position after the whole has become ossified. There is no appearance of any duplicature of the pericarpial covering of the ovary, and its subsequent agglutination, as described by the eminent botanist referred to: it will be found to exist only in the endocarpial portion. The development, as I have explained it, is even more evidently demonstrated in the seed-vessels of *Ileocarpus* and *Stephania*, where the hippocrepical cell is formed round a flat, solid, orbicular disk, in the substance of which the nourishing vessels can be traced, as in the pseudo-dissepiment of *Cissampelos*.

In a group which I have called *Heterocliniæ*, the growth is somewhat varied: there, in the early stage, the ovule is attached as described in *Cissampelos*; but the placenta, from which it is suspended, is like a broad oval disk upon the inner face of the cell; and while the ovary continues to increase equally in all directions, the increment about the placentary space is somewhat less: this face of the cell thus gradually assumes a convex shape inside, and the placenta swells into a globular figure, forming

sometimes a hollow prominent chamber within the cavity of the cell, round which the seed is moulded and becomes fungilliform and attached to it by its short line of raphe and chalaza. In *Odontocarya*, *Jateorhiza*, *Calycocarpum*, and *Aspidocarya*, the inner face of the putamen is nearly flat, or only slightly convex within, the placenta does not swell and form a vacant chamber, and the seed remains suspended from its normal point of attachment, the raphe and chalaza, more or less free from the epicarp, being clearly manifest along the middle face of the seminal integument. Thus it will be found that the fruit and seed, in the several genera, assume different shapes and degrees of development, to be hereafter detailed, furnishing constant and valuable distinguishing characters.

For the facility of concisely describing the peculiar enlargement of the placenta, which acts so important a part in the development of the putamen and seed, I proposed many years ago to call it a *condylus*, because the seed is articulated upon it as a socket. The use of this term has been objected to (as I think, somewhat hypercritically) by the learned authors of the 'Flora Indica' (p. 169), because they consider it improper to apply specific terms to modifications of structure peculiar to single orders; and they prefer to designate the same as a "processus internus condyliformis putaminis"—a term more objectionable, because more circumlocutory. If the term "*condylus*" is to be rejected on account of its use in zoological science, then we ought to discard the words "umbilicus, placenta, vagina, vitellus," &c., as well as other designations commonly used by botanists with much advantage, such as "retinaculum, hypanthium, gynophorus, oehrea, rostellum, corona, labellum," and a number of others peculiar to certain orders. I therefore still think it advisable to give a comprehensible designation to that important development which, in the *Menispermaceæ*, offers a good and constant character for generic purposes.

The fruit in the *Menispermaceæ* is drupaceous, of an oval, gibbous, or pyriform shape, consisting of a membranaceous coloured pericarp, sometimes hairy, covering a more or less fleshy mesocarp, and enclosing a solid putamen. When the number of ovaries is three or more, some of them prove abortive and fall off, leaving distinct scars upon the gynæcium to which they were attached. These drupes are sometimes sessile upon the gynæcium; but in other cases the base of each drupe is narrowed and prolonged into a stipitate support, so that there is no immediate contact of the putamen with the gynæcium; in other cases, besides this stipitated support, each drupe is articulated upon a distinct emanation of the gynæcium, which is pedicelliform, as in *Tiliacora*, where it is comparatively short; but in

Sciadotenia this emanation becomes elongated in an extraordinary manner: in this case the number of ovaries is constantly nine, uniserially sessile upon the summit of a columnar gynæcium; in the course of its growth a process is generated beneath each ovary, which becomes elongated in the form of a long pedicel on which the fruit is articulated; so that they bear the appearance of an umbel of nine distinct flowers, each bearing a single seed. This was the inference I drew when I first saw the plant*; but I was soon afterwards convinced of the true nature of this development, on obtaining a specimen where in some of the flowers eight of the ovaries remained sessile and abortive upon the gynæcium, while only a single fruit was carried up by the pedicel-like expansion of nearly three times the length of the seed. This curious development, which some years afterwards was noticed by Mr. Benthams†, is evidently the growth of the gynæcium, not of the ovary, which is articulated on its summit, and leaves a scar when it falls off, while the pedunculiform expansion remains solidly attached to the gynæcium.

The structure of the endocarp is deserving of some consideration. With few exceptions, it becomes hardened into a firm and often osseous nut, more seldom into a chartaceous putamen, which is sometimes thin and horny. In all the *Leptogoneæ* and *Platygoneæ*, where the cell is curved round a central condylus, the outer rim of the putamen is transversely marked with several broad and deep crenelures; and as the shell is of uniform thickness, the seed becomes indented with corresponding impressions. In the *Heterocliniææ*, where the form of the nut is usually oval or orbicular, the external surface, though sometimes smooth, is frequently covered with tubercular or irregular cristate projections; and sometimes, upon the internal and ventral surface of the cell, across each side, numerous more or less elevated cristate plates project, which enter into corresponding fissures of the albumen, much after the manner seen in the seeds of many of the *Anonaceæ*. In *Odontocarya* and *Jateorhiza*, genera of the *Heterocliniææ*, and in *Hæmatocarpus* among the *Pachygoneæ*, the putamen is covered with an extremely dense tomentum, formed of innumerable fine simple hairs or fibres which are imbedded in the pulpy mesocarp. In *Anomospermum*, the drupes of which I examined in the living state, the mesocarp consists of a number of fleshy masses, each about a line in diameter, which, by mutual pressure, are somewhat angular; they adhere together with some tenacity, and can only be removed from the putamen by force. A number of cancellated furrows, filled with ligneous

* Ann. Nat. Hist. ser. 2, vii. 43. † Journ. Linn. Soc. v. Suppl. p. 51.

fibres, are seen on the surface of the putamen, corresponding with the lines of junction of these gland-shaped masses. After the fruit has become dried, these glands cannot be detected, though the cancellated furrows always remain. Similar cancellated furrows, filled with fibres, are seen on the putamen in *Coscinium* and *Anelasma*, whence it may be inferred that, in the ripe state, their mesocarp is constituted as in *Anomospermum*.

The seed, in all the Menispermaceous plants that have fallen under my observation, is covered by two thin membranaceous integuments, the inner one being of delicate texture; the raphe is always found on the ventral face of the outer one, in the form of a thickened line of a darker colour; and here generally is seen a thin carinated duplicature of this integument, extending along the whole length of the placenta, and this duplicature enters into a corresponding furrow on the condyle, by which, at the period of maturity, the seed is found attached.

Albumen is present in the genera of all the tribes, except in those of one, where it is altogether wanting. In the tribes *Leptogoneæ* and *Platygoneæ* it is simple and homogeneous; in *Anamirta*, among *Heteroclineæ*, it is nearly so. In *Anomospermum* and in most of the *Tiliacoreæ*, where the embryo is terete, the thick circumambient albumen is cleft transversely, almost to the centre, by numerous fissures, into which the integument enters, thus producing a ruminated structure similar to that seen in the *Anonaceæ*. In the *Heteroclineæ* the albumen consists of two nearly distinct plates, that on the dorsal face being like a thin simple lamina, while that on the ventral side is much thicker and deeply cleft, as before mentioned, by a number of irregular fissures penetrating nearly its whole depth. In the *Pachygoneæ*, where the albumen is wanting, the embryo occupies the entire space of the cell.

The form of the embryo is various. In all the genera of the *Leptogoneæ* it is slender and terete, with the radicle equal in diameter to the cotyledons, and nearly of equal length, sometimes a very little longer or a little shorter. In *Anomospermum* the embryo is also slender and terete; but the cotyledons, which are coequal in diameter with the radicle, are ten times its length. In *Tiliacora*, where the embryo is of similar form, the cotyledons are only twice the length of the radicle. In all the *Platygoneæ* the radicle is always terete; but the cotyledons are flattened, subfoliaceous, and at least double its breadth, often much broader. Throughout the preceding instances, the cotyledons are adpressed and contiguous, as in ordinary cases, being *accumbent* in the *Pachygoneæ*, *Anomospermeæ*, and *Hypserpeæ*, but *incumbent* in the *Tiliacoreæ*, *Leptogoneæ*, and *Platygoneæ*: these are important distinctions, that merit more attention than they have

obtained. The embryo is of a very different and very peculiar form in all the *Heterocliniæ*, where the cotyledons are extremely thin, foliaceous, and present the singular anomaly of being widely and divaricately spread on a plane parallel with the external face.

When, after careful study, I first attempted to classify the *Menispermaceæ*, it became manifest, from the foregoing evidence, that the floral parts, always of diminutive size, were little adapted for this purpose; but by adopting as a basis the development of the fruit, it was easy to establish several valid and well-defined groups. An interval of nearly sixteen years has tended to confirm this conviction; and accordingly the same arrangement which I formerly adopted is here repeated, with some modifications, by dividing the family into seven well-marked tribes, in the following manner:—

Tribe 1. HETEROCLINIÆ. The putamen here is generally osseous, rarely chartaceous, somewhat compressed antically and postically, 1-locular, with an internal umboniform or globular condylus in the middle of its ventral face, which is often divided into two chambers by a partition, to which the more or less meniscus-shaped seed is attached in the manner before mentioned, the line of the raphe with a portion of the integuments being drawn into this partition, from which it is difficult to detach it. But sometimes the condyle entirely vanishes in a mere umboniform depression of the ventral face of the nut, correspondingly convex within the cell, the seed being suspended from near its summit by a mere point or extremity of the raphe which is seen continuous upon the free integument, running down its ventral face: this modification occurs in *Calycocarpum*, *Jateorhiza*, *Fibraurea*, *Parabæna*, *Aspidocarya*, and *Odontocarya*. It should be mentioned, as a general character of the tribe, that the remnant of the style is always seen near the summit of the drupe, or comparatively little removed from it. The embryo is consequently nearly orthotropous, with large foliaceous cotyledons placed laterally and divaricately on the same plane, and imbedded in distinct cells of the albumen, which is thin and homogeneous on the dorsal side, always thicker on the ventral portion, which latter is most frequently deeply cleft or ruminated by numerous fissures, as in *Anona*, the radicle being short, terete, and superior.

Tribe 2. ANOMOSPERMÆ. Here the style is on the apparent summit of the drupe, whose stipitate support is on one side of the longer diameter of the fruit, so that the style is more or less excentric to the real base of the drupe, which, properly speaking, is transversely or obliquely oval and gibbous. The putamen is coriaceous, and the seed is quite cylindrical and straight for

two-thirds of its length, and more or less uncinately curved at its base. In both cases the seed is folded upon a perpendicular internal laminiform condyle, which protrudes from the ventral face of the putamen nearly to the centre of the cell, where it terminates in a longitudinal placentiferous margin; the copious albumen which fills the cell is deeply ruminated in all directions by numerous clefts; the integuments penetrate these clefts, and also cover the deep longitudinal groove formed by the projecting condyle, to the placentiferous margin of which they adhere along the line of the raphe. The embryo is nearly anatropous, a little bent or partially heterotropous, very slender, terete, and elongated, with cotyledons of the same diameter as the very short terete radicle, which is quite superior and only one-tenth of their length: these are accumbent, and placed on the axis of the albumen. The sepals are imbricated in æstivation, and the free fleshy petals separately embrace and almost conceal the stamens.

Tribe 3. TILIACOREÆ. The drupe is so extremely gibbous that the style is seen near the base of the fruit. The putamen is transversely oblong, laterally compressed, sulcated by a central line along the middle of each face, and rendered bimarsupiate by a long, horizontal, septiform, internal condyle; the cell (and therefore the seed) is hippocrepiform; the albumen is deeply cleft or ruminated, as in the last tribe, the integuments penetrate its sinuosities, and they adhere to the condyle along the line of the raphe. The embryo, which lies in the centre of the albumen, is elongated, hippocrepiform, and nearly terete; the radicle, pointing to the style, is of the diameter of the cotyledons, and about equal to them in length; they are always incumbent (not accumbent, as in the former tribe). The sepals of the inner row are slightly imbricated in æstivation in some genera, and valvate in others.

Tribe 4. LEPTOGONEÆ. The growth of the fruit is equally excentric as in the last tribe, so that the style is always seen near the base. The putamen is generally osseous, nearly orbicular, laterally very compressed, forming a crescent-shaped or nearly annular cell circumscribed round the edge of an external peltiform condyle, a portion of the integuments along the line of the raphe being drawn into a fissure of the condyle. The embryo partakes of the cyclical form of the cell, is slender, elongated, and terete, with incumbent cotyledons (not accumbent as in Tribe 2), equal in thickness and length to the terete radicle, the whole being imbedded in the middle of simple albumen; the radicle at the extremity of the upper horn points to the style. The sepals are imbricated in æstivation. In one section of the tribe (*Cissampelidæ*) the number of floral parts is greatly reduced in the female flowers.

Tribe 5. *HYPSPERPEÆ*. The style here also is seen near the base of the fruit, in consequence of its excentric growth. The putamen is formed as in the preceding tribe, and the embryo, imbedded in simple albumen, is of the same slender proportions; but the cotyledons are accumbent (not incumbent). The sepals in æstivation are either imbricated or valvate, and the flowers are sometimes remarkable for being very unsymmetrical in the relative number of their parts.

Tribe 6. *PLATYGONEÆ*. The style here also is near the base of the fruit. The putamen either resembles that of the *Tiliacoreæ* in shape, divided by a septiform condyle, having a hippocrepiform cell, or the condyle is subglobular and often 2-camerate, variously perforated, to the edge of which the integuments are attached, as in the two last tribes, the cell being in this case cyclical. The seed is either 2-crural or cyclical; the embryo is imbedded in the middle of the albumen, which fills the cell, partakes of its form, has large incumbent cotyledons, as in the *Leptogoneæ* (not accumbent); these are flattened and foliaceous, twice or three times the breadth of the more slender terete radicle, and always from two to six times its length; the radicle in the upper horn points to the style. This is a very natural and well-marked division, and ought on no account to be confounded with the two former.

Tribe 7. *PACHYGONEÆ*. The style, as in the three former groups, is near the base of the fruit, or it is more removed from it. The putamen is generally coriaceous, with a septiform condyle, which is sometimes almost obsolete. Unlike all the other tribes, the embryo is here quite exalbuminous, so that it entirely fills the cavity of the hippocrepiform or reniform cell, the radicle being extremely short and small, pointing to the style, the cotyledons being very large, extremely fleshy, cyclically curved and accumbent. These characters render it one of the most natural divisions of the family.

The authors of the 'Flora Indica,' in their arrangement of Asian *Menispermaceæ* (in 1855), were the first to adopt the principle of the above distribution; but they made several objectionable alterations in it, losing sight of some of the more prominent and constant characters, and adopting others of less value. They divided the family in a somewhat different manner, some of their groups being extremely heterogeneous. Their first tribe (*Coscinieæ*) offers no character different from my *Heteroclinieæ*; the latter was adopted by them as their second tribe, but they changed its name to *Tinosporeæ* without any advantage; the former designation certainly better expresses the very peculiar and most salient character of the group—that of their divaricated cotyledons imbedded in distinct cells of the

albumen. Their fourth tribe consists of my subdivision *Cissampelideæ*, which they separated from the rest of my *Leptogoneæ*. They abolished my tribe *Tiliacoreæ*, which offers such distinct characters, and united the only Indian genus belonging to it with the rest of the *Leptogoneæ*: these, together with my *Platygoneæ*, constituted their third tribe, *Cocculææ*—a name especially objectionable on account of its old association with *Anamirta Cocculus* (the *Cocculus* of commerce), and thus likely to lead many persons into error: in this group different forms of embryo are mixed together, and the important distinctions between accumbent and incumbent cotyledons are totally disregarded. Their fifth tribe is adopted upon my *Pachygoneæ*, with little alteration.

Messrs. Bentham and Hooker, in their 'Genera Plantarum,' published a few months ago, have followed in the steps of the authors of the 'Flora Indica,' but have avoided some of their errors, and properly discard the *Coscinææ*; they have, however, followed the same principle of distribution. They adopt my *Heterocliniææ* (under the name of *Tinosporeæ*) as their first tribe, and my *Pachygoneæ* as their fourth tribe; they also separate my subtribe *Cissampelideæ* from the rest of the *Leptogoneæ* as their third tribe; while for their second tribe, under the objectionable name of *Cocculææ*, they confound together my *Anomospermeæ*, *Tiliacoreæ*, the remainder of the *Leptogoneæ*, and all the *Platygoneæ*, thus mixing up heterogeneously opposite conditions of albumen, and different forms of embryo, and totally disregarding the important distinction of accumbent and incumbent cotyledons—characters fully appreciated by them in other families. This, no doubt, has been done with a view to concentration; but it cannot be denied that it is effected at the sacrifice of consistency. It appears to me that, if we profess to adopt a principle as a basis of division, it should be carried out strictly. The feature of ruminated albumen is too peculiar to be so overlooked; and hence the *Anomospermeæ* and *Tiliacoreæ* are deserving of special places, and should be held distinct, not only because of having quite a different direction of the condyle, but on account of one having accumbent, the other incumbent cotyledons. It is for this latter reason that I have ventured to add a new tribe, *Hypserpeæ*. The marked contrast between the slender thread-like embryo of the *Leptogoneæ*, as contradistinguished from those with foliaceous cotyledons, many times the breadth of the slender radicle, is too important to be passed over; and hence the necessity for maintaining the *Platygoneæ* as a distinct tribe. The differences in floral structure are of secondary importance; and for this reason the *Menispermeæ* and *Cissampelideæ* have been retained by me as subtribes, and conjoined into a single tribe

(*Leptogoneæ*), in which all the genera are alike distinguished for one uniform character of embryo. I think, therefore, it will be conceded that my distribution is based on more consistent principles; and I perceive no disadvantage whatever in having as many as seven well-defined tribes, seeing that this is not an uncommon number accorded to other families by the authors of the 'Genera Plantarum.' It will be noticed that the same eminent botanists have changed the names of my tribes, calling them after some particular genus which, as before shown in *Cocculææ*, may be very inappropriate: by this no advantage is gained; on the contrary, it is far better to name a tribe, wherever it can be done, by its principal distinguishing feature, which at once recalls to mind the group to which any plant belongs: thus the names *Heterocliniææ*, *Leptogoneæ*, *Platygoneæ*, and *Pachygoneæ*, speak for themselves more readily than *Tinosporeæ* and *Cocculææ*. This method has been extensively followed in that great work, the 'Prodromus,' of DeCandolle, from which no inconvenience whatever has yet arisen.

In their distribution of the *Menispermaceæ*, the eminent botanists before mentioned annul several genera which appear to me to stand on valid ground: among these they are decidedly in error in excluding my genus *Odontocarya*, not only from the *Heterocliniææ*, but from the order altogether, referring it to *Euphorbiaceæ*: its carpological features all conform unquestionably with those of the *Heterocliniææ*, and place it in immediate affinity with the genus *Aspidocarya* of the 'Flora Indica.' *Aneasma*, though a very good genus, has been discarded by the same authorities, who have likewise condemned *Batschia*. For these, and some other genera in like manner suppressed by them, the evidence will be given on which they have been maintained.

After mature reconsideration of all the facts relating to the differences in structure in the several genera, I feel bound to adhere to my previous distribution of the *Menispermaceæ*, formed by many years of attentive study and careful analyses. It must be remembered that when this investigation was undertaken little was known of the extremely varied structures in this family—structures resolvable into several well-marked groups; for it is evident that the meagre information previously recorded was based upon a large amount of error, as will be seen by reference to the 'Prodromus' of DeCandolle and Endlicher's 'Genera Plantarum.' It was not till my "Remarks" were published in 1851, that some light began to gleam on the subject; even then a mere outline only was given of the new facts obtained, the details of which remain yet unpublished. These will now be given in succession, and will be afterwards illustrated by some of the numerous drawings made at the time of the examination.

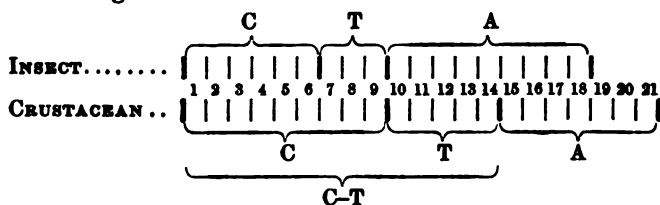
The question of the affinities of the group was considered in my first "Remarks on Menispermaceæ" (Ann. Nat. Hist. ser. 2. vii. 34): this has since been so ably discussed by the authors of the 'Flora Indica' (p. 170) that it is unnecessary to go over the same ground, as I concur in most of their views on the subject. The relationship towards *Lardizabalaceæ*, *Magnoliaceæ*, and *Anonaceæ*, as is there shown, cannot be doubted; but this is not so considered in the new 'Genera Plantarum,' where the apocarpous order *Lardizabalaceæ* is transferred as a mere tribe into the monocarpous family of *Berberidaceæ*, and that of the *Canellaceæ* (intimately related to this last family) is carried far away and placed between *Violaceæ* and *Bizaceæ*: this appears to be a very illogical view of their true relationship. The apocarpous *Thalamifloræ*, with parietal placentation, constitute so natural a group, and are connected together by so many similar characters, that it is difficult to conceive why any of them should be placed elsewhere; and, in regard to *Canellaceæ*, the fact of having two or four lines of parietal placentation, as in some *Lardizabalaceæ*, the resemblance of the ovary and seed to those of *Drimys* (especially in the shape and position of their small embryo), their many-seried imbricated sepals and petals (as in *Magnoliaceæ*), their extrorse anthers (as in *Anonaceæ*), the extrorse monadelphous stamens (as in many *Menispermaceæ*), their solitary carpel (as in *Berberidaceæ*), and the resemblance to the whole of these orders in their mode of placentation, are characters extremely manifest*. The weight of this evidence leads to the conclusion and confirms the opinion that the *Canellaceæ* should rest in contiguity with *Berberidaceæ*, osculating at the same time with the above-mentioned apocarpous group, and not with *Bizaceæ* or *Violaceæ*, with which they have little analogy. If these eminent authorities had classed the *Canellaceæ* where they have placed the *Lardizabalaceæ* (before *Berberidaceæ*), and had retained the *Lardizabalaceæ* in their former position among the climbing polycarpous families, near *Menispermaceæ*, such an arrangement would have met with the general accord of botanists; and this it is to be hoped they will be induced to do in a second edition of their important work.

* Having lately defined the characters of the *Canellaceæ* (Contrib. Bot. i. 112, pl. 23, 24), I cannot be considered presumptuous in venturing to differ in opinion from the above-mentioned eminent botanists, who acknowledge the resemblance of the seeds to those of *Winteraceæ*, but who object that the *Canellaceæ* differ widely in the structure of the perianth, stamens, and ovary. This can hardly be conceded; for if we compare the sepals and petals of *Cinnamodendron* (pl. 24) with those of *Drimys* (pl. 26) or of *Illicium*, they will be found to accord in a remarkable manner; and if we conceive the extrorse stamens of *Drimys* united by their margins, we have precisely the staminal tube of *Canella*; in like manner, by joining the five

II.—On the Homologies of the Insectan and Crustacean Types.

By JAMES D. DANA.

IN a note to the article on Cephalization (*Annals*, 1863, vol. xii.), at page 198 a brief statement is made by the writer on the relations between the structures of Insects and Crustaceans. The following diagram and explanations will make the subject more intelligible:—



The diagram presents to the eye the succession of normal segments in the two types—that of the Insect or highest Insectan, and that of the Decapod or highest Crustacean (including Crabs, Lobsters, &c.). The spaces between the vertical lines stand for the segments, which are numbered from 1 to 21. C stands for the cephalic portion or head; T, for the thorax; A, for the abdomen; C T, for the cephalothorax.

The number of normal segments in a Crustacean has been so clearly and conclusively demonstrated by Milne-Edwards that it is unnecessary to add here to what has already been said on the subject. The series and its subdivisions are illustrated in the line above, opposite CRUSTACEAN: *fourteen* segments are shown to belong to the cephalothorax, and *seven* to the abdomen. It is established beyond all doubt that each segment corresponds to a single pair of members, as follows:—number 1 to the eyes, 2, 3, to the two pairs of antennæ; then, in the *Decapod*, 4, 5, 6, 7, 8, 9, to organs of the mouth (or mandibles, maxillæ, and maxillipeds); 10, 11, 12, 13, 14, to feet; and 15–21 to the abdomen*.

The abdominal members in all Decapods which have them, and four or more posterior pairs of thoracic members or feet in degradational forms of Decapods (as in *Gastrurans* or the *Squilla* group and in *Schizopods*), are *two-branched*, or have two jointed terminations proceeding from the second segment: and this is the nearest approach in Decapods to that duplication of the

carpels of *Drimys* by their margins into one, we have exactly the ovary of *Cinnamodendron* with its sessile stigmata and five lines of placentation, as shown in pl. 24.

* In the Tetradeapod, 4, 5, 6, 7 pertain to organs of the mouth, and 8, 9, 10, 11, 12, 13, 14 to feet.

pairs of legs to each segment which occurs in the *Iuli* and some other related Myriapods*.

As the true normal limit of the head in an animal is determined by the fact that this part includes the senses, mouth, and mouth-appendages (for this is demonstrated by the principles of cephalization already explained, if not established on other grounds), the *head* in the Decapod includes *nine* segments, and the *thorax* *five*, although there is no constriction of the body to make the division obvious to the eye.

The relation of the Insect-type to the Decapod is at once apparent from a comparison of the two lines in the preceding diagram. Supposing the parallelism rightly presented, the following facts are to be noted:—

1. The Insect-type wants the three posterior segments of the Crustacean.

2. The head and thorax together of the Insect-type have the same number of segments (nine) as the head alone of the Decapod.

3. The head and thorax of the Insect-type contain *half* of its total number of segments (eighteen); the same of the Decapod-type contains *two-thirds* of its total (twenty-one).

4. The head of an Insect contains six segments, which is *one-third* of the total in the Insect-type; that of a Decapod nine segments, or *three-sevenths* of the total in the Crustacean type. [The head of a Tetradeapod, it may be added, contains seven, or *one-third* the total.]

5. The visceral segments (or those containing the viscera connected with digestion) are the 10th, 11th, 12th, 13th, 14th, in both the Insect-type and the Decapod-type. But in the Insect the 10th is the first behind the thorax; and in the Crustacean it is the first behind the head (or the mouth-organs)†.

* The writer has suspected that the multiplication of segments in the Phyllopods might be due to the basal part of each pair of feet becoming a separate body-segment, and that the branches corresponded to the double feet of the *Iuli*; but, as the members in these multiplicative types appear often (if not always) to have the full number of basal joints, this view does not appear to be tenable.

† Only in a degradational group of Decapods (that of the Gastrurans) do the viscera reach into the abdominal segments, or those following the 14th. The abdomen is very much elongated in these species, the cephalo-thoracic portion of the body is comparatively small, and the whole structure is lax and low in grade. The species thus stand apart from the Macrurans as a separate tribe, equivalent to those of Brachyurans and Macrurans, while the Schizopods are only degradational Macrurans. See 'Annals,' *l.c.* In the fact that the viscera of the Squilloids or Gastrurans are contained in the *abdominal* portion of the animal, this group appears to approach the order of Insects. But this seeming approximation comes, as observed, through degradation, and is analogous to that between a *Limulus* and an Insect, as explained on page 193.

The last two or three normal segments in Insects (that is, the 16th, 17th, and 18th) are frequently wanting.

In the above homological comparisons it is assumed that the three anterior normal segments present in a Crustacean are normally and potentially present in an Insect. This will be considered by many as the doubtful point in the above comparisons. But it is proved to be correct by the fact that these three segments are sense-bearing segments in Crustaceans, and the Insect fails in no sense belonging to the Crab. As stated on page 188 (*Annals, l. c.*), the absence of a jointed organ is no proof of the absence of the segments, unless it be true also that the corresponding sense is wanting.

If the constitution of the anterior part of the head in the Insect be still questioned, there is nevertheless good reason for making the mandibular segment in the Articulate type (as it adjoins the centre in embryonic development, from which progress goes on forward and backward) normally identical in all groups under that type; and hence from this segment, or No. 4 in the Crustacean series, on to No. 18, the parallelism between the Insect and Crustacean must be rightly given; consequently, if there is any doubt, it holds only with regard to Nos. 1, 2, and 3. The law of unity of structure under a type seems, however, to preclude even this chance for doubt.

Comparing the higher Decapods among Crustaceans and the higher Insects, the mean size or mass is about as 50 to 1. This ratio indicates approximately the amount of condensation in the Articulate structure connected with the elevation of grade from the typical Crustacean to the typical Insectean.

III.—*On Freshwater Rhizopoda of England and India; with Illustrations.* By H. J. CARTER, F.R.S. &c.

[Plates I. & II.]

THE object of this communication is to bring together descriptions and illustrations of the freshwater Rhizopoda which I have found in England since my return from India in 1862, and also to add some of those which from time to time came under my notice in the island of Bombay, in order that I may, to a certain extent, show what species are common to both localities, and also some of those which may be peculiar to Bombay, or at least may not yet have been described.

Further, I have drawn most of these on the same scale, and have added some of their varieties respectively, so that an idea may be thus gained of their sizes generally, as well as of some of their differences in point of shape; for, unless they are treated

in this way, we shall never be able to get on without much confusion either in describing them or in distinguishing their species. Mere descriptions at this period of their history will not suffice, as those of Schlumberger testify (Ann. des Sc. Nat. t. iii. p. 254, 1845), especially where a single or only a few specimens of the species have been obtained, because numbers are required for comparison, to establish a species; and although a figure may not be absolutely necessary with a great number of specimens of the same species, it, for the same reason, becomes absolutely so with one or only a few of it. It is only by numbers that we can arrive at the typical form of the species, here as well as in the Rhizopoda generally, where those who are well acquainted with them know that the varieties are almost infinite.

Appended to the descriptions will also be found "Observations," in which any structural or physiological fact bearing on the species only, or in connexion with the Rhizopoda generally, that appeared to me deserving of notice, has been mentioned. This is particularly the case under *Diffugia compressa*, a new and interesting species, which has been found so abundantly that I have been able to make out almost as much about it as about *D. pyriformis*.

AMÆBA.

Amæba princeps, Ehr.

This species often occurs in Bombay as well as in Europe, and often with the villi on the posterior extremity, first pointed out by Dr. Wallich. I have given a description and illustrations of it (Annals, 1863, vol. xii. p. 30), chiefly for the purpose of pointing out the occasional presence in it of certain cells which appear to me to be reproductive elements; and have nothing more to add concerning it here, saving allusion to the corrections or altered views respecting the nucleus, which will be found at page 254 of the same volume.

Amæba quadrilineata, Cart. (Annals, 1856, vol. xviii. pl. 5. f. 3);
A. radiosa (?), Duj. (*ibid.* figs. 10–16); and *A. verrucosa*,
 Ehr., Annals, 1857, vol. xx. pl. 1. fig. 12.

I have already figured these as they occur in Bombay. *A. radiosa* was only thus named provisionally; but since I have returned from India, and have seen Auerbach's paper on the *Amæbæ* (Zeitschrift für wissenschaftl. Zoologie, Dec. 31, 1855), which just preceded my own in publication, it seems evident to me that this species would be better termed *A. bilimbosa*, which Auerbach has figured as a new species.

Another *Amæba* to which I should allude here is that which I have delineated with the last-mentioned, and have also pro-

visionally called *A. Gleichenii*? (figs. 5-8), showing its different stages from the active to the passive capsuled condition, as it affords the only instance that I have ever noticed of an *Amæba* becoming covered with a distinct, peculiar, brown, chitinous (?) capsule. It was observed at Bombay, just before the commencement of the "rainy monsoon," on the 13th of June 1855; and the figures in my journal are accompanied by the following remarks:—

"Took some water from a tank in the garden, which had become nearly dry, leaving the shallow pool which remained in it scattered over with patches of *Oscillatoria*, and the water rendered green by the presence of *Euglena*. Found this water nearly filled with large *Amæbæ*, which were very active and contained fresh green and brown or half-digested food; also a number of circular, colourless, semitransparent, apparently capsuled, refractive bodies, of different sizes, the largest $\frac{1}{8}$ th of an inch in diameter [these, at the time, I viewed as "ovules;" they may have been the "reproductive cells;" they could hardly have been starch-granules, from their circular form]; a large spherical nucleus containing a faintly marked nucleolus, a contracting vesicle, and granules. Having put some scores of these into a little clean water in a watch-glass, at 12 o'clock in the day, I found that the greater part of them, by 10 a.m. on the following day, had become respectively enclosed in a round, conical, rough, brown capsule, which was attached to the watch-glass by its point or by a short pedicle prolonged therefrom. Many others were seen in different stages between the most active and the entirely fixed and capsuled condition, as represented in the figures to which I have referred. It was remarkable to witness the increasing density of the pellicle, as indicated by the difficult and sudden way in which the sarcode every now and then burst through the surface of those individuals which, although uncapsuled and still transparent, were already fixed by their pedicle to the glass. Some of the largest of these *Amæbæ*, in a subround state, measure $\frac{1}{8}$ th of an inch in diameter. In their most active condition they moved about by globular expansions; and in no instance did I observe any pointed ones. Perhaps this kind of polymorphism may have been induced by the thickening of the pellicle, and at another period the pseudopodia might have been pointed. The sides of the tank, which was excavated in trap-rock, were scattered over with dried masses of *Spongilla*, and the little water that was left in it bestrewn with their capsules."

I tried to repeat the experiment just mentioned; but *Coleps*, the most destructive of all the Infusoria, became developed in the watch-glass, which appeared overnight to contain nothing

but the *Amœba*, and the next morning presented absolutely nothing but *Coleps*. The "rains" then set in, filled the tank, and destroyed all trace of these *Amœba*, since which period I have never met with a similar occurrence.

Amœba monociliata, n. sp. Pl. II. fig. 19.

Polymorphic, charged with granules; possessing a single large cilium and villi on the posterior extremity.

Hab. Fresh water. Locomotion reptant.

Loc. Bombay.

Obs.—I remember this specimen well. It stands figured in my journal for May 1855 under two forms, as represented in the plate, with no mention of the size, or anything more than has been above stated. In the presence of the flagelliform organ we seem to have perpetuated the one or two cilia with which the young or monadine forms of the Rhizopoda, so far as my knowledge extends, are generally provided, but which disappear as they grow older, leaving the more developed form inferior in point of locomotive organs to the less matured one. Whether the cilium of *A. monociliata* could be retracted or not I am not enabled to decide, because I never observed more than one specimen. But that we have an instance of this power in the Rhizopoda is seen, not only in the young of *Acineta* (which, on issuing from the parent, commence with cilia which finally become retracted and give place to capitate tentacula), but also in the division of the free or stemless species, where one half only puts forth cilia till its separation is thus completed, and then retracts them again, to be followed by tentacula, as in the young one—a fact which is well worth remembering, whether it bears upon the question of *A. monociliata* being able to retract its cilium or not, since it affords another instance of the extraordinary extemporizing power of the Rhizopoda, viz. that of being able to put forth vibratile cilia and retract them as the occasion may require—organs which, in the other Infusoria, when once developed, appear to be as unalterable in form as their motions seem to depend on fixed muscular machinery.

It is possible that this so-called species may be but a variety of *Podostoma filigerum*, Clap. et Lachm. (p. 441, pl. 21. figs. 4–6); but, as above stated, I never saw but one specimen, and this did not remain sufficiently long under observation to undergo more changes in form than those which I have figured.

· *DIFFLUGIA*, Ehr.

Diffugia pyriformis, Perty (mihi).

A detailed description of this species will be found in the 'Annals' (ser. 3. vol. xii. p. 249), and I have nothing further to

add to it here, except that certain bodies in the sarcode, which I supposed to be larger starch-granules, now appear to me to have been cells analogous to, if not homologous with, the "reproductive" ones described in *Amœba princeps*, which will presently be seen to exist also in *D. compressa*, n. sp.

The type form (perhaps) of the test of *D. pyriformis*, with its varieties—together with delineations of the animal, its nucleus in a spheruliferous condition, also in the effete state after the spherules have passed into the body, and, finally, their development in the watch-glass—will be found in Pl. I. figs. 1, 2, 3, & 4, illustrative of all that has been described in the paper to which I have alluded. It should be remembered, however, that, if (in fig. 1) the animal part had been shaded sufficiently deep to represent its normal green colour, it would be nearly black. Both the faint yellowish tint and the form of *D. oblonga*, Ehr. (tab. 9. fig. 2), seem identical with the generative stage of *D. pyriformis* that I have termed "colourless."

Diffugia compressa, n. sp. Pl. I. figs. 5 & 6.

Test lagenoid, compressed, circular posteriorly, elongated into a short neck, with even aperture anteriorly*; composed of hyaline grains of quartz-sand held together by a gelatinous (albuminous?) substance; presenting a dark, undulating, collar-like mark at the junction of the neck with the body of the test. Animal composed of diaphane and sarcode, the latter charged with "moleculæ," "granules," portions of undigested food, starch-granules, yellow oil-globules, and small brown cells, which latter appear to impart to it its characteristic light-brown colour. Granules minute, colourless. Nucleus probably posterior, but not seen *in situ*; vesiculæ or contracting vesicles also probably posterior and marginal, as in *D. pyriformis*.

Hab. Heath-bog water. Abundant among conjugating confervoid Algæ and Desmidiæ. Progressing with the oral aperture downwards and the test erect. Locomotion and capture of food performed by obtuse digital prolongations of the body slowly projected from the aperture. The "brown cells" do not enter the pseudopodia.

Size. Length $\frac{3}{8}$ th, greatest breadth of broad side $\frac{1}{10}$ th, aperture $\frac{3}{16}$ nd, greatest breadth of narrow side $\frac{1}{8}$ th, aperture $\frac{1}{12}$ th of an inch.

Loc. England; south coast of Devon, Budleigh-Salterton.

Observations. They were found in abundance about the middle of September, in company with conjugating confervoid Algæ, &c., as

* Of course, where the test is covered with grains of sand, the outer margin of the aperture must be rough; but where these grains are absent or scanty, the inner one is found to be smooth and even.

above stated, which formed a slimy layer over the surface of a drain adjoining a heath-bog. Out of upwards of 200 specimens, the largest average size was that above given. There is considerable variety of shape, even to that of a circular figure (*k*); but all have the characteristic compressed form (*c*) from which I have designated the species; all present a light brown colour, and most of the tests have that peculiar collar-like mark (*ff*) round the neck above mentioned. Neither the nucleus nor the vesiculæ could be seen *in situ*, on account of the opacity of the tests; and until one is found sufficiently transparent to admit of this, these points must remain undetermined. I did not meet with a single specimen of *D. pyriformis* among those of *D. compressa* where the latter so abounded, although they are both very plentiful at their respective localities in the same neighbourhood, and both in ditches draining the same heath-bog; but while *D. pyriformis* prevailed among dead leaves only, *D. compressa* was chiefly found in company only with the conjugating Algæ mentioned. Still I found specimens of *D. compressa* with *D. pyriformis*, and am now inclined to believe that those which I have considered to be *D. proteiformis*, Ehr., in my "Observations" on *D. pyriformis* (*l. c.*, p. 250), were specimens of *D. compressa*, the compressed form of which would easily be mistaken for globularity; for, when passive, this species always rests on its broad surface, and its compressed form is not seen until it be turned over, or until the animal becomes active and assumes the erect position. Further, I am inclined to think that they must have been specimens of *D. compressa* because this species is so generally distributed throughout the same neighbourhood, and, lastly, because they did not present the "deep olive or greenish colour" which I now find (*ap. Pritchard*) is one of the characteristic features of *D. proteiformis*. It is true that the size of *D. proteiformis* is set down (*l. c.*) as much less than that of *D. pyriformis* and that of *D. acuminata*, Ehr.; but this matters little, and the characteristic form also of *D. proteiformis*, viz. "ovate subglobose," is so near that of *D. pyriformis*, that there remains no specific difference that I can now see, to disunite these so-called species. Thus, after all, *D. pyriformis*, Perty, may be but a larger and more elongated form of *D. proteiformis*, Ehr., in which case the original name should be retained for the typical form, whichever that may be.

On submitting *D. compressa* to pressure, and crushing the test in water under a glass cover, as stated in my paper on *D. pyriformis*, the animal part was found to consist of protoplasm charged with colourless moleculæ, small brown cells, yellow oil-globules, starch-granules, the nucleus, certain large cells which I shall provisionally term "*reproductive*," and portions of food

in process of digestion. Thus there are no chlorophyll-cells as in *D. pyriformis*, but small brown cells, yellow oil-globules, and reproductive cells, all of which do not appear in the latter, unless, as above stated, I have mistaken the "reproductive cells" in *D. pyriformis* for large starch-granules, which the sequel will, I think, make probable. Let us now review these parts more in detail.

1. Small brown cells (Pl. I. fig. 6*b*). These are globular in form, filled with granular protoplasm, and about $\frac{1}{80}$ th of an inch in diameter, not near so numerous or so striking as the chlorophyll-cells in *D. pyriformis*, although they, with the yellow oil-globules, appear to give the light brown colour to the species.

2. Oil-globules (*c*). These are more striking than in *D. pyriformis*, from their constant presence, greater number, and bright amber-colour: they vary in size, and, under the application of a solution of iodine in iodide of potassium, lose their yellow colour, but only to become more brilliant and refractive.

3. Starch-granules (*d*) and nucleus (fig. 6). The same as in the green specimens of *D. pyriformis*, where the latter has become spheruliferous. The nucleus is also about the same size, (the $\frac{1}{10}$ st part of an inch in diameter), but the spherules more marked and sometimes granuliferous. As the nucleus in all the specimens which I examined, and which were very numerous, was in the same condition, while in its original state it probably bore the usual appearance, viz. a circular discoid body (the nucleolus) attached to the inner surface of a larger translucent and spherical cell (the nucleus), it may be that this is the state in spring, and the former the autumnal one, indicative of the time of the year at which the animal generates.

4. Reproductive cells (*e, f*). These are certain cells of an oval or circular shape, filled with homogeneous contents, colourless, more or less refractive, and generally about $\frac{1}{40}$ th of an inch in diameter, but varying to twice this size or more, even in the same animal. They also vary in number, from ten to twenty or more, and have been seen frequently both with and without the presence of the nucleus in its spheruliferous condition. On the application of iodine, they, for the most part, assume a light amber colour, and sometimes present granuliferous contents (*f*), which distinguishes them at once from the starch-granule; but they also present occasionally a claret-colour, although never so deep or with such homogeneous contents as the starch-granule.

As before stated, I suspect that these cells also exist in *D. pyriformis*, and that I have mistaken them there for large starch-granules.

In no instance have I yet found the body of *D. compressa*

charged with the "granuliferous cells" and the nucleus empty, as in the colourless specimens of *D. pyriformis*, although, as above mentioned, these cells have sometimes been seen to have arrived at the granuliferous stage in the nucleus. Then I have not found any indication here to direct me to this condition, as in *D. pyriformis*, where the absence of the green colour at once shows that the spherules of the nucleus have passed into the body of the animal. Probably it does take place here as well as in *D. pyriformis*; but this remains to be seen.

Still it is perhaps worth recording that in one specimen an abortive nucleus was found, in which there were not only a few of the spherules remaining, but starch-granules and yellow oil-globules also, such as occur in the body of the animal, showing that where the development of the spherules fails of its object, the elements of which they are composed may pass into other compounds. On the application of iodine to this nucleus, the remaining spherules assumed their usual amber tint, the starch-granules a deep claret one, and the yellow oil-globules lost their colour, as in the body of the animal under similar circumstances; while the contents of the nucleolus, which were homogeneous, also (as usual) received a claret tint which, although not so deep as that of the starch-granules, yet always, in this respect, indicates in these contents a more amylaceous composition than in those of the nuclear cavity.

Of what import are the "reproductive cells" of *D. compressa*, which appear to be homologous with those described in *Amæba princeps*?

It may be seen that, while I have described and figured certain granuliferous cells, &c., which occasionally accompany the reproductive cells in *Amæba princeps*, still I could never recognize in any of these a true nucleus (*l. c.* p. 42, pl. 3. fig. 1 *d, e*). But I have done so in *D. compressa*, and, as above stated, have seen the reproductive cells in company with a spheruliferous nucleus. However, I have observed and figured in *Amæba princeps* (fig. 5, *l. c.*) one of the reproductive cells twice the size of the others, which I have also interpreted as a yet undivided reproductive cell. On the other hand, Dr. Wallich (if we both refer to the same kind of bodies) states (*Annals*, ser. 3. vol. xii. p. 124) that he has seen, in his *A. villosa*, a nucleus among them; and, where these cells have been less numerous, "three distinct nuclei," of almost equal size. The latter, I think, must be what I have considered undivided reproductive cells—that is, under the view that these cells are multiplied by duplicative division, which, in the large ones mentioned, is a little retarded. But be that as it may, we have in *D. compressa* the spheruliferous nucleus and these reproductive cells together

in the same animal; and I have already stated that the spherules of the nucleus, after passing into the body of *D. pyriformis*, ultimately appear in the watch-glass with ciliated polymorphic bodies, whereby we may fairly infer that the same changes take place in those of *D. compressa*. What, then, becomes of the "reproductive cells" in *D. compressa*? Now, assuming, as we have done, that the reproductive cells in *D. pyriformis* were mistaken for large starch-granules, and remembering also not only that the spherules were ciliated, but also that *Amæbæ* much larger in size were among the contents of the watch-glass (Pl. I. fig. 4 a, b), which were inferred to come from the colourless specimens of *D. pyriformis*, in which the spherules had passed into the body of the animal, is it not worthy of consideration whether the latter (that is, the *Amæbæ*) may not have come from the reproductive cells? and, therefore, whether the spherules of the nucleus may not bear the relation of spermatozooids to these reproductive cells? If so, too, in some instances, the granulation of the nucleus may take place in one, and the formation of the reproductive cells (from a larger subdivision of the nucleus) in another individual—thus rendering the species diœcious; while others may be both monœcious and diœcious. It would be easy for impregnation to take place in the body of the *Diffugia*, where both the spherules of the nucleus and the reproductive cells might come together in a preeminently plastic state for their union, although it be true that in many instances the procreative elements of other organisms eliminate themselves from the parent and get into the water before this act takes place: at the same time here it must occur quickly, or the formation of a pellicle over the surface of the protoplasm of the germ-cell or sperm-cell (which it does not appear to be in the power of either to control) inevitably defeats the process.

There is another question also which I have not yet been able to determine, viz. whether or not the chlorophyll-cells in *D. pyriformis* and the brown cells in *D. compressa* are not identical with those bodies in the *Amæbæ*, &c., which I have termed "granules" (Annals, ser. 3. vol. xii. p. 83 &c.). In the amœbous cell of *Spongilla* they are frequently of a bluish emerald-green colour under the microscope, and, in some instances, appear to impart the green colour to the mass. Again, in *Amæba princeps*, &c., they frequently pass into crystalloids; while I have seen and figured them also in the pseudopodia of *Diffugia tricuspis*, Cart. (Annals, ser. 2. vol. xviii. pl. 7. fig. 80), and in those of *Arcella vulgaris*, Ehr. Yet in those of *D. pyriformis* and *D. compressa* I have never seen anything but a dense number of fine granules, which look like those with which the sarcode is charged, and to which I have given the name of "moleculæ." Hence I

have stated, in the description both of *D. pyriformis* and of *D. compressa*, that neither the chlorophyll-cells nor the brown cells enter the pseudopodia of either of these species respectively; at the same time that I might have erred in calling their contents granules instead of molecu $\text{l}\ddot{\text{a}}$ e, if the chlorophyll-cells and brown cells should hereafter prove to be homologous with the "granules". We shall find the latter particularly marked in *Euglypha compressa*, n. sp., and in *Cyphoderia margaritacea*, Schlum., where they are globular in the former and oblong in the latter (Pl. I. fig. 18 k, & Pl. II. fig. 18 l).

Diffugia urceolata, n. sp. Pl. I. fig. 7.

Test ovo-globose, truncated anteriorly; aperture wide, even; margin everted, reflected; neck obsolete: composed of grains of hyaline quartz-sand. Animal colourless, hidden, with the exception of the pseudopodia, by the opacity of the test.

Hab. Heath-bog water. Progressing with the aperture downwards and the test erect. Locomotion performed by obtuse digital prolongations of the body slowly projected from the aperture.

Size. Length $\frac{1}{3}$ rd, breadth $\frac{1}{4}$ nd, aperture $\frac{1}{16}$ th of an inch in diameter.

Loc. England; south coast of Devon, Budleigh-Salterton.

Obs. I have only seen one specimen of this species, and in this the animal was fortunately present and active. On crushing the test, no nucleus or starch-granules appeared, but a dozen cells (c), each of which was about $\frac{1}{16}$ th of an inch in diameter, and so much like the earlier or acapsular stage of the "reproductive cells" of *Amæba princeps* that little doubt could be entertained of their being of the same nature. There was nothing present, either to represent the chlorophyll-cells or brown cells of *D. pyriformis* and *D. compressa* respectively, unless a number of elongated, elliptical, colourless bodies, which I took to be the "granules," might have been thus considered (fig. 7 d).

Diffugia Bombayensis, n. sp. Pl. II. fig. 16.

Test ovo-globose, of a dark-brown colour, truncated anteriorly, aperture even; composed of grains of sand externally, which rest upon a cancellated structure formed of circles of large particles, in the areas of which are scattered a number of smaller ones. No part of the animal seen within the test, on account of its opacity. Pseudopodia numerous, digitiform, obtuse or forked at the extremity.

Hab. Fresh water.

Size. About $\frac{1}{16}$ th of an inch long.

Loc. Island of Bombay.

Obs. Annexed to the figure of this in my journal is the following note (Sept. 1855):—"There are two *Diffugia* [in the island of Bombay], viz. one small, ovoid, almost colourless, and about $\frac{1}{10}$ th of an inch in length; test covered with grains of quartz-sand, sometimes with particles or bodies of equal length laid side by side in regular arrangement, as in *Arcella aculeata*, Ehr. Conjugates like *Euglypha*; flesh shrinks up into a round form at the bottom of the test. [This is probably the species which I have called *D. tricuspis*, l. c. pl. 7. fig. 80.] The other much larger," &c. [This is the species last described.]

Attached to the figure of another ovo-globose specimen (in my journal), covered with hyaline grains of quartz, but not brown, is also this note (July 1855), viz.:—"A large *Diffugia*, with sandy test, translucent, and about $\frac{1}{10}$ th of an inch long."

The last measurement probably equals that of any English species of *Diffugia*; and as the same shape is often figured in my Bombay journal, although of much smaller dimensions than this, it is probable that they all belong to the "ovo-globose" species of this locality, of which the maximum size is that just mentioned. The habitat is fresh water. If thought desirable, it might be named "*D. ovoglobosa*."

Diffugia elliptica, n. sp. Pl. I. fig. 26.

Test ovo-elliptic, compressed, pointed posteriorly, truncated anteriorly, with even aperture; composed of hyaline grains of quartz. No part of the animal seen but the pseudopodia, which were digitate and obtuse.

Hab. Fresh water.

Size. $\frac{3}{8}$ th of an inch long, and $\frac{1}{12}$ th transversely on the broad surface.

Loc. Island of Bombay.

Obs. I have only one specimen of this form figured. It differs from *D. compressa* in having the posterior part of the test pointed, and the anterior part without extended neck; hence I have designated it differently; but, as "one swallow does not make a summer," so one specimen is not enough to establish a species, and therefore the name may be considered provisional.

Diffugia peltigeracea, n. sp. Pl. I. fig. 12.

Test flask-shaped, transparent, with wide mouth and double inflation, viz. one in the body, and the other towards the aperture; composed of minute, irregular, polygonal scales in juxtaposition. Animal colourless; nucleus posterior.

Hab. Found about *Peltigera canina* (Dog-Lichen).

Size. Length $\frac{1}{17}$ th, greatest breadth $\frac{3}{10}$ th, aperture $\frac{1}{15}$ th of an inch.

• *Loc.* Tavistock, Devon.

Obs. Only two specimens of this Rhizopod were obtained—viz. one containing the animal in a passive state, and the other empty. They were found in the water which had been poured over some specimens of *Peltigera canina*, to moisten them; and these specimens had been brought from the neighbourhood of Tavistock. Figures of both tests are given to show that there is some little variety in their shape; and the small one is drawn upon the same scale as that of the *Diffugia* generally, to show its relative size. In the test containing the animal, the latter will be observed to be retracted, and, as usual under such circumstances, to have secreted a kind of fibrous structure, which is arranged transversely, in the form of a diaphragm, towards the aperture. Portions of undigested food are seen in the body; and the presence of two of these around the nucleus (one of which is posterior to it, in which position it never occurs in *Euglypha*) makes me call this Rhizopod, provisionally, a *Diffugia*, although the form of the pseudopodia can alone settle this question, which thus must be left for future observation to determine.

Diffugia spiralis, Bailey (mihi). Pl. I. fig. 9.

This species is also very common here. I never saw it in the island of Bombay. It is generally covered with grains of hyaline quartz, but still not unfrequently with minute, short, cylindrical, colourless filaments, arranged parallel to each other, although in a more or less tortuous manner (*d*). In Dr. Wallich's figure of this species, under the name of "*Diffugia proteiformis* (var. *septifera*)" (Annals, ser. 3. vol. xi. pl. 10. fig. 12), the covering appears to consist of little subround bodies, of uniform shape; and in that of *D. acuminata*, Ehr., close by, it is observed (p. 453)—"the portion of the test around the aperture is built up entirely of chitinous pellets."

Diffugia — ? Pl. I. figs. 10, 11.

The tests of two other *Diffugia* (figs. 10 & 11) were both found in heath-bog water, with *D. urceolata*, the former empty, the latter containing the animal; but as these were the only specimens of this shape met with, I have merely inserted their figures for what they may hereafter prove worth.

ECHINOPYXIS, Clap. et Lachm.

Echinopyxis aculeata, Ehr. (sp.) Pl. I. fig. 8.

Common in the island of Bombay, as well as on the south coast of Devon, at Budleigh-Salterton. The largest specimens that I have seen in the latter locality measured about $\frac{1}{16}$ th of an inch long, and about the same transversely in the broadest

part, the anterior half being rather contracted, and the aperture large and circular, or slightly elongated transversely. The latter feature, together with the tendency of the aperture to an ex-centric or terminal position and the depression of the test anteriorly, while it is elevated behind, causes this Rhizopod to bear a similar relation to *Diffugia* that the pleurostomatal form of *Euglypha* (*Trinema acinus*, Duj., *Euglypha pleurostoma*, Cart.) bears to the latter genus; and when we observe that its test is formed of grains of hyaline quartz, and that the pseudopodia are digital and obtuse, the alliance is still greater. The spines then become the chief distinguishing character, out of which, according to Claparède and Lachmann (p. 447), delicate pseudopodal prolongations are projected. But even the spines vary greatly in number and position (*i, d*), while in some varieties they are altogether absent (*g, h*), as may be seen by the group of figures I have given of them, which, being all drawn upon the same scale, show not only their relative sizes to each other, but to those of the other *Diffugia*.

In the lateral view of the large specimen (*d*), I have endeavoured to give another variety in the disposition of the spines, and have figured on the test the regular arrangement of short straight filaments (*e*) which, at Bombay, I found occasionally substituted for the grains of quartz; while in other instances the test was composed of a mixture of both, and sometimes of the frustules of *Navicula pusilla* (mihi) only, with the endochrome still in them. Thus, as we have now seen, these animals avail themselves of much variety in the material of their covering, although grains of sand, and especially of colourless hyaline quartz, seem to be preferred.

ARCELLA, Ehr.

Arcella vulgaris, Ehr. Pl. II. fig. 14.

Among the figured specimens of this Rhizopod and its varieties are the largest that I have seen; and in the horizontal view of the depressed form will be observed the double nucleus, viz. one situated diametrically opposite the other. This occurs also in all the varieties; and I wonder that no allusion has been made to the circumstance by other authors who have written on this Rhizopod, especially since my figure illustrating the fact was published in 1856 (*Annals*, ser. 2. vol. xviii. pl. 7. fig. 79). I think that I have found specimens with only one nucleus, but certainly none with "twelve or fifteen," as stated by Auerbach and repeated by Claparède and Lachmann (p. 445). But I have figures of specimens, observed in the island of Bombay, containing even more than this number of what appear to me now to have been "reproductive cells" analogous to those which

I have described in *Amœba princeps*. In a figure of *A. vulgaris* which was active, there are twenty-one of these cells represented; and in another of the faceted variety (*A. angulosa*, Ehr.), which was passive, these cells are all gathered up into the body of the animal, which has thus assumed a compressed circular form corresponding with that of the interior of the test, and in this state much resembles the condition of *A. princeps* when the body, filled with reproductive cells, has become almost effete and barely forms more than a protective covering to them. (Annals, ser. 8, vol. xii. pl. 8. fig. 4). *Euglypha alveolata* is also represented in a similar state (Annals, ser. 2, vol. xviii. pl. 5. fig. 26). Hence I think it possible that the authors above mentioned may have mistaken these cells for nuclei; at the same time, the apparent areolation of the nucleus, which arises from the circular semi-opaque nucleolus being much smaller than the more transparent nuclear cell, is at the same time as characteristic of the nucleus as it is distinctive of it from the "reproductive cell," which has no areolation. It is, however, possible, as I have inferred in *A. princeps*, that these cells may arise from a division of the nucleus; and this, if I am right in my conjecture, may have led to their having been called nuclei.

The depressed, arched, elevated, and faceted forms of *Arcella* respectively, one would have concluded, *à priori*, to have been all variations from one type form, if this had not been confirmed by Claparède and Lachmann (p. 446) through actual observation; and that type form one would further conclude to be *A. vulgaris*, if there were not room for doubt still left respecting the probable passage of the new test produced by the *variety* returning to the original form,—that is, if the sagacious observers just mentioned had not only established that all the varieties which they have mentioned may come from *A. vulgaris*, but also that these varieties never returned to it. Beyond this I have nothing to add to their excellent article on the subject, saving that, if the green colour of *A. viridis*, Perty, should depend upon the presence of chlorophyll-cells, then I think this should be considered a distinct species.

My figures are chiefly intended to bring the principal varieties together, for the purpose of showing their resemblance to each other, the identity in form of their pseudopodia with those of *Diffugia*, and their size relative to the other Rhizopoda which are illustrated with them. They all are as common in the island of Bombay as here on the south coast of Devon.

Arcella patens, Clap. et Lachm. (p. 446, pl. 22. fig. 7).

This species (very like Ehrenberg's *Pyxidicula operculata*, tab. x. fig. 1, and placed by this illustrious microscopist among

the Diatomaceæ) stands figured in different parts of my journal since 1855, as it is found in the island of Bombay, and now copied into Plate II. fig. 15. Its diameter there does not exceed the $\frac{1}{100}$ th part of an inch, which is less than half the size of the species found near Berlin by Claparède and Lachmann; but, like that, the test is hemispherical, open below, and the nucleus and vesicula single; while, unlike it, the test of the Bombay specimens is light-brown or fawn-coloured. Portions of food were observed in it; and I think the pseudopodia were more pointed than those of *Arcella vulgaris*—thus more resembling those of *Amœba*. It was found abundantly in fresh water, creeping over filaments of *Spirogyra* and *Cladophora*. I have not yet met with it on the south coast of Devon.

One of the figures in my journal is subspherical, apparently in preparation for forming a new individual by duplicative division, and thus represents the new half a little less in size, and much lighter in colour, than the older one,—which not only makes it resemble the *Pyxidicula* (c) figured by Ehrenberg under a similar condition, but also the globular frustules of the chain-like Diatomaceæ (e. g. *Melosira*) when, under division, their hemispherical form is supplying the new half. I think, by and by, much alliance will be found to exist between the Rhizopoda and the Diatomaceæ.

EUGLYPHA, Duj.

Euglypha compressa, n. sp. Pl. I. fig. 13.

Test ovate, compressed, convex, more or less expanded laterally, terminating in a sutural edge all round, except at the aperture, which is 10–12-denticulated; composed of elongated hexagonal scales in juxtaposition, except at the aperture, where their free ends are pointed; furnished with about twenty hairs or spines irregularly scattered along a little more than the posterior half of the sutural line. Animal occupying the whole of the test, except towards the centre, where it is constricted, and thus forms a line of demarcation between the anterior opaque portion, which contains the food, and the posterior or transparent one, which contains the nucleus together with a great number of colourless cells. The latter, globular in figure, with strongly defined edge, appear to be the “granules.” Vesicula in plurality, situated opposite the constricted portion of the body.

Hab. Heath-bog water. Progression erect, or with the aperture downwards. Locomotion and capture of the food performed by pseudopodia, which are straight, attenuated, ray-like, and of variable length.

Size. Length $\frac{1}{100}$ th, breadth $\frac{1}{100}$ th, thickness in the mid-

dle $\frac{1}{10}$ th, aperture $\frac{1}{10}$ th, body-scales $\frac{1}{10}$ th long by $\frac{1}{10}$ th of an inch broad.

Loc. South coast of Devon, Budleigh-Salterton.

Obs. Of this Rhizopod I have only found two specimens, one a little broader and shorter than the other. It strictly agrees with *Euglypha alveolata*, as may be seen by my figure of the latter (Annals, ser. 2. vol. xviii. pl. 5. fig. 25), in the essential features of the genus, but differs from it specifically in its compressed form (after which it has been designated), its sutural edge, restriction of the hairs to this line, and in the figure of the scales.

Euglypha alveolata. Pl. II. fig. 17.

The accompanying figure of this species is to show that it may possess at least twelve hairs scattered over the posterior part of the test, or in a variable number down to their complete absence; also to show that the body-scales of the specimens here found are circular and overlap each other, giving the area an hexagonal form, and not an oval one, as that of the scales of the specimens found in the island of Bombay, to the illustration of which I have just referred; further, that the pointed ends of the scales around the aperture present serrated edges under a high power, that is, under a $\frac{1}{2}$ th-of-an-inch object-glass.

CYPHODERIA, Schlumberger (mihi)*.

Cyphoderia margaritacea, Schlum. Pl. II. fig. 18.

This, although extremely common here (south coast of Devon), I have never met with in the island of Bombay. It has been figured to show how far it agrees and how far it differs from *Euglypha*. The test varies in form occasionally by the presence of a diverticulum posteriorly, which is more or less extended, as in *Diffugia acuminata*, and which I have never seen in *Euglypha*. During progression, the test is inclined, corresponding with the oblique direction of the aperture, which, in all the testaceous Rhizopoda when in motion, is brought into parallelism with the plane on which they may be creeping, and thus determines the position of the test under these circumstances. The scales of the body are more or less regularly hexagonal and in juxtaposition, but not denticulated (as in *Euglypha*) at the aperture, which, in *Cyphoderia margaritacea*, presents a beaded edge, *c.* But it is not until we come to the pseudopodia that we find any very marked difference between this genus and *Euglypha*, and here only in their length, branched condition, the rapidity with which they are projected (more resembling those of *Trinema acinus*, Duj. = *Euglypha pleurostoma*, Cart.), and the peculiar

* See description *ap.* Pritchard, p. 557, ed. 1861.

manner in which they are suddenly retracted, with or without the prehension of a particle of food—the latter seemingly produced by the distending power which kept the semifluid sarcode in a ray-like form being suddenly withdrawn, when the sarcode, accumulating into a kind of drop at the end of the filament, incepts the particle of nourishment, and gradually, by amalgamative union, withdraws it and itself into the body of the animal.

Interiorly the body so strictly accords with that of *Euglypha* that I have assumed that the vesiculæ (which I have not yet seen in *Cyphoderia*) are in like manner situated opposite the constriction (for the convenience of emptying themselves there?), and therefore have provisionally placed them in this position in the figure. In the posterior translucent part, which contains the nucleus and "granules," the latter will be observed to be oblong or elliptical, and not globular as they are in *Euglypha compressa*.

The two figures of the test (*d, e*) on a smaller scale are given respectively, to show the acuminate variety, and for comparison in size with the rest of the figures.

Sometimes the animal, instead of extending back to the posterior extremity of the test, is attached, a little distance from it, to the upper limb by a digital prolongation, in which I have seen a contracting vesicle fill and discharge itself.

The largest specimens that I have met with have been about $\frac{1}{800}$ th of an inch long, $\frac{1}{800}$ th broad, the aperture $\frac{1}{160}$ th by $\frac{1}{180}$ th, and the scales $\frac{1}{8000}$ th in diameter.

A marine species (specimen?) has been described by Prof. Schultze under the name of *Lagynis Baltica*, out of which he has made the genus *Lagynis* (Organ. der Polythal. p. 56, tabb. 7 & 8. fig. 1).

ACTINOPHRYS, Ehr.

Actinophrys paradoxa, n. sp. Pl. II. fig. 20.

Polymorphic; surface even, or furnished with capitate and actiniform tentacula, separately or together; capitate tentacula short, numerous, forming a villous surface over the body, retractile or extensile; actiniform tentacula few in number, long, radiated, and much larger than the rest. Incepts crude material for food. Neither nucleus nor contracting vesicle seen.

Hab. Common in the freshwater tanks of the island of Bombay, from April to June inclusive.

Size. About $\frac{1}{800}$ th of an inch in diameter.

Obs. This species has been designated from its changeable form—viz. at one time appearing without any tentacula, and at another with one or both kinds present. Figs. *a, b, c* represent changes of form successively seen in the same individual; and *d* is

assumed to be the same species, with the tentacula in a capitate form and of various lengths, the capitate portion not being so distinct in *b* and *c*, where these tentacula are but just put forth beyond the body. But that it incepts crude food, I should have considered it an *Acineta*. I have not seen this Rhizopod in England.

It is right, however, to add that the same form, and undergoing the changes above mentioned, once occurred in company with that peculiar cyst of *Acineta* which is surrounded by transverse circular ridges, out of one of which cysts I have (*p, m*) figured, *doubtfully*, its exit. But, be this as it may, the specimens contained no crude food, and were more or less densely charged with the granules so characteristic of *Acineta*. Can it be that this Rhizopod, after all, is an *Acineta* which both lives on suction through the capitate bulbous tentacula and on crude food, like *Actinophrys*, as the occasion may require?

Actinophrys Eichhornii, Ehr. Pl. II. fig. 21.

Of this Rhizopod I only met with two specimens in the island of Bombay, of the size given, in eight years, in different localities and at a long interval of time, both in fresh water. The first had no pseudopodia, but presented the vesicula in plurality and in the forms given in the figure (*f, f*), as well as the cell (*g*) supposed to be the nucleus. Both specimens contained much crude food, and the last specimen seen was more or less scattered over with actiniform tentacula. In each instance, the body was filled with a parenchyma consisting of vacuoles suspended in granular sarcode. The vacuoles appeared to be spherical in their primary form (*c*), and each contained granules in active motion, while the granular sarcode alone was projected into the form of tentacula, which bore with them a covering of the plastic investing membrane, as represented in the drawing (*a, a*). The vesiculæ made their appearance between the surface of the parenchyma and the investing membrane, and, bursting through the latter, were followed by protrusion of the parenchyma, as shown at *e*. Each specimen was about $\frac{1}{16}$ th of an inch in diameter; and that figured is drawn upon the same scale as most of the other delineations, viz. $\frac{1}{16}$ th to $\frac{1}{8}$ th part of an inch.

Fig. 22 (whose body was only $\frac{1}{16}$ th of an inch in diameter, but contained vacuoles similar to those of *A. Eichhornii*, was in the same basin with and was probably only a small specimen of it) presented on different parts of its actiniform tentacula little globules, apparently of the substance of which the investing membrane is composed. In the same basin was also an *Actinophrys* in which all the tentacula radiated from one point of the body (*Plagiophrys spherica*, Clap. et Lachm. p. 454?), and also

many specimens of *A. oculata*, Stein (mibi), in aggregated masses of nine or more individuals held together by their united sarcodes, in the midst of which were spaces containing large cells of homogeneous, semiopaque, colourless matter, like those of the marine species figured by Stein: but of this gregarious form I hope to write more hereafter.

Figs. 23 & 24 represent yet two more species (or, perhaps, varieties) of *A. Eichhornii*. In both, the plastic investing membrane is seen to be carried out in an arachnoid form beyond the body; but in fig. 23 only was the nucleus and a portion of crude food observed; while in the two specimens of fig. 24 seen (one with and the other without the arachnoid expansion) there was nothing, according to my notes, but colourless granules. Hence this, with the capitate tentacula, makes it look like *Acineta*; but its general appearance, and the probability that the hastiform extremities of the tentacula are merely accumulations of the plastic investing membrane, incline me to the side of *Actinophrys*.

ACANTHOCYSTIS, nov. gen.

Acanthocystis turfacea, n. sp. Pl. II. fig. 25.

This species is described at p. 263 of the 'Annals' (ser. 3. vol. xii.) and fully illustrated in Pl. II. fig. 25, &c., while a detailed account of the illustrations will be found in the 'Explanation' to the plate. I have nothing more to add here to my description, except that, if *A. viridis*, Ehr., be *A. brevicirrhis*, Perty, coloured by chlorophyll, as suspected by Claparède and Lachmann (p. 452), then the description of the latter given at p. 450 makes it also very like *Acanthocystis turfacea*; but the two descriptions will be found to be by no means identical.

EXPLANATION OF THE PLATES.

N.B. The tests in Plate I. figs. 1, 5, 7-11, 12g, 13f, 14a, g, i, l, m, and 26, and in Pl. II. figs. 15g, 16, 17, 18d, e, and fig. 21, are all drawn upon the scale of $\frac{1}{4}$ th to $\frac{1}{10}$ th of an inch, in order that their relative sizes may be seen.

All the figures are, of course, more or less diagrammatic, for the purpose of description; but nature has been departed from as little as possible.

PLATE I.

Fig. 1. *Diffugia pyriformis*, Perty (mibi), magnified: a, test; b, grains of hyaline quartz; c, pseudopodia; d, diaphane; e, dentiform attachments of the same to the test; f, sarcodæ; g, chlorophyll-cells; h, food; i, nucleus; k, k, vesiculæ or contracting vesicles; l, acuminate variety of test; m, pyriform variety.

Fig. 2. The same, spheruliferous nucleus of: a, nucleolus; b, imaginary section of the same; c, central cavity; d, layer of nuclear proto-

plasm bearing the spherules; *e*, nucleolus, with layer of granules and central cavity; *f*, chlorophyll-cells; *g*, starch-granules. All these figures are greatly magnified.

Fig. 3. The same, effete nucleus of the colourless specimens, after the spherules have passed into the body of the animal: *a*, flocculent matter, the remains of the nuclear protoplasm in which the spherules were suspended; *b*, nucleus, with layer of granules and central cavity still remaining; *c*, granuliferous cells (originally the spherules of the nucleus, which have now passed into the body of the animal) undergoing multiplication by duplicative division; *d*, starch-granules. All greatly magnified.

Fig. 4. The same: *a*, granuliferous cells after they have passed from the animal into the watch-glass, now become ciliated; *b*, small *Amœbæ* which also appear in the watch-glass. All greatly magnified.

Fig. 5. *Diffugia compressa*, n. sp., magnified: *a*, broad side of test; *b*, grains of hyaline quartz-sand; *c*, narrow side; *d*, grains of quartz on the same; *e*, *e*, pseudopodia; *f*, *f*, dark collar-like mark at the base of the neck of the test; *g*, *h*, *i*, *k*, dotted lines showing respectively varieties in the form of the test; *l*, aperture of the circular variety. It should be remembered that the grains of quartz, &c., are only partially delineated over the test, to save trouble in the engraving.

Fig. 6. The same, spheruliferous nucleus of; the spherules more or less granuliferous: *a*, nucleolus; *b*, brown cells; *c*, yellow oil-globules; *d*, starch-granules; *e*, reproductive cells; *f*, one under the effect of iodine, showing that it is granuliferous, and not homogeneous like the starch-granule under the same circumstances. All greatly magnified.

Fig. 7. *Diffugia urceolata*, n. sp., magnified: *a*, grains of quartz; *b*, pseudopodia; *c*, reproductive cells; *d*, oblong colourless cells or bodies (the "granules"?). The two latter much more magnified than the test.

Fig. 8. *Diffugia aculeata*, Ehr.; magnified under surface: *a*, grains of hyaline quartz; *b*, aperture; *c*, *c*, spines; *d*, lateral view of the same, showing a different arrangement of the spines; *e*, minute pieces of straight filaments, sometimes substituted by the animal for grains of sand; *f*, pseudopodia; *g*, oblong variety, without spines—under surface; *h*, lateral view of the same; *i*, circular variety, with spines all round.

Fig. 9. *Diffugia spiralis*, Bailey (mili); magnified lateral view: *a*, test; *b*, grains of hyaline quartz; *c*, posterior view; *d*, short filaments arranged parallel to each other, but in a tortuous form, substituted for grains of quartz.

Fig. 10. *Diffugia* —? magnified. Test empty; animal not seen.

Fig. 11. *Diffugia* —? magnified; colourless: *a*, pseudopodia.

Fig. 12. *Diffugia peltigeracea*, n. sp. (provisionally so named), magnified; scale $\frac{1}{12}$ th to $\frac{1}{3750}$ th of an inch: *a*, test; *b*, form of scales; *c*, body of animal in a passive state; *d*, nucleus; *e*, *e*, *e*, portions of food; *f*, fibrous matter forming a kind of diaphragm; *g*, another form of the same on the scale of $\frac{1}{12}$ th to $\frac{1}{3750}$ th of an inch (for comparison in size with the rest of the tests on this scale).

Fig. 13. *Euglypha compressa*, n. sp., magnified; scale $\frac{1}{12}$ th to $\frac{1}{3750}$ th of an inch: *a*, broad side of test; *b*, scales near aperture; *c*, the same, a little further back; *d*, spines; *e*, narrow side; *f*, broad side, on the scale of $\frac{1}{12}$ th to $\frac{1}{3750}$ th of an inch (for comparison)

g, pseudopodia; *h*, body of the animal; *i*, nucleus and nucleolus; *k*, "granules," (?) *globular* in shape; *l, l*, vesiculæ *in situ*.

- Fig. 26. *Diffugia elliptica*, n. sp., provisionally so named: *a*, broad side of test; *b*, posterior extremity viewed from above, showing its compressed form; *c*, pseudopodia. Indian specimen.

PLATE II.

- Fig. 14. *Arcella vulgaris*, Ehr., magnified: *a*, test; *b*, form of plates; *c*, aperture; *d*, animal attached to the test by dentiform processes; *e, e*, the two nuclei situated opposite each other; *f*, vesiculæ in great plurality; *g*, lateral view; *h*, form of pseudopodia; *i*, lateral view of more elevated variety; *k*, pseudopodia; *l*, horizontal view of faceted variety; *m*, lateral view of the same.
- Fig. 15. *Arcella patens*, Clap. & Lachm. (mihi), magnified: *a*, under surface of test; *b*, body of animal; *c*, nucleus; *d*, vesicula; *e*, upper view; *f*, lateral view; *g*, size of test on the scale of $\frac{1}{4}$ th to $\frac{3}{8}$ th of an inch (for comparison).
- Fig. 16. *Diffugia Bombayensis*, n. sp., magnified: *a*, grains of quartz; *b*, cancellated structure of the test beneath, in circles; *c*, pseudopodia.
- Fig. 17. *Euglypha alveolata*, Duj., magnified; furnished with twelve hairs: *a*, form and arrangement of body-scales, more magnified; *b*, serrated edges of apertural scales, as seen under $\frac{1}{4}$ th-inch focus. Loc. South-east coast of Devon.
- Fig. 18. *Cyphoderia margaritacea* (Schlumberger), magnified, on the scale of $\frac{1}{4}$ th to $\frac{3}{8}$ th of an inch: *a*, test; *b*, form of scales; *c*, beaded form of apertural margin; *d*, test less magnified, viz. on a scale of $\frac{1}{4}$ th to $\frac{3}{8}$ th of an inch (for comparison); *e*, ditto, acuminate variety; *f, f*, pseudopodia, more or less branched; *g, h*, forms under retraction, the latter incepting a particle of food at its extremity; *i*, body of the animal, containing fragments of nutritious matter in progress of digestion; *k*, nucleus, surrounded by *l* oblong "granules" (?); *m*, vesiculæ opposite the constriction of the body, situated as in *Euglypha* (assumed position).
- Fig. 19. *Amœba monociliata*, n. sp., magnified; under two different forms: *a*, cilium; *b*, villous appendage on posterior extremity.
- Fig. 20. *Actinophrys paradoxa*, n. sp., magnified: *a*, simple form; *b*, the same, covered with capitate tentacula, the capitate portion not visible, probably from their shortness and evenness in length; *c*, ditto, with both capitate and actiniform tentacula; *d*, ditto, with the capitate portion now become visible, and these tentacula of different lengths. The figures *a, b, c* represent changes witnessed successively in the same individual; *d* represents another individual, assumed to be of the same species, with the capitate cilia fully developed: this is the commonest form, perhaps because most easily recognized.
- Fig. 21. *Actinophrys Eichhornii*, Ehr., magnified; scale $\frac{1}{4}$ th to $\frac{3}{8}$ th of an inch (for comparison): *a, a*, investing membrane seen extending up the actiniform tentacula, also covering the contracting vesicles; *b*, vacuoles with which the body is densely charged; *c*, the same, more magnified, showing the granules within their interior, which are so remarkable for their active motion (probably owing to that of the protoplasm in which they may be suspended); *d*, actiniform tentacula, formed of the granular protoplasm of the parenchyma only, but sheathed apparently throughout with the investing membrane (I did not see any of the vacuoles in the

granular protoplasm of even the largest tentacula); *e* represents a portion of the parenchyma which appears to protrude after rupture of a contracting vesicle (thus apparently showing that the fluid contents of this organ are expelled externally); *f, f*, vesiculæ or contracting vesicles; *g*, nucleus? *h*, bodies like the "reproductive cells;" *i*, portions of food in process of digestion, among which is a rotiferous animalcule; *k*, a tentaculum, truncated in the drawing only. N.B. The body has not been filled up with the vacuolar parenchyma, nor have the actiniform tentacula been scattered over it, as in nature, to save trouble in the drawing, &c.

Fig. 22. The same, magnified small specimen of (?), with the actiniform tentacula bearing little pellets of the investing membrane (?).

Fig. 23. The same; another specimen (?), where the investing membrane is carried out by the tentacula into an arachnoid form; the body presenting the nucleus and a portion of crude food.

Fig. 24. The same; another specimen (?), where the investing membrane has not only been carried out into an arachnoid form, but apparently has also assumed a hastate form at the ends of the tentacula respectively.

Figs. 22-24 are drawn upon no scale, but in body may be set down as about $\frac{1}{100}$ th or $\frac{1}{100}$ th of an inch in diameter respectively.

Fig. 25. *Acanthocystis turfacea*, n. sp. et gen., magnified; on the scale of $\frac{1}{100}$ th to $\frac{1}{100}$ th of an inch: *a*, body; *b*, minute, curved, fusiform spicules covering the capsule; *c, c, c*, forked spines; *d, d, d*, tentacula, granuliferous; *e*, nucleus; *f*, vesicula discharging itself; *g*, chlorophyll-cells; *h*, starch-granules; *i*, a spine, more magnified; *k*, proximal or discoid end; *l*, distal or forked end; *m*, more magnified representation of a fusiform spicule.

IV.—On the Animal and Affinities of Fenella; with a List of the Species found in the Seas of Japan. By ARTHUR ADAMS, F.L.S. &c.

IN the 'Annals' for 1860 I described some exquisitely sculptured little shells under the common appellation of *Dunkeria*, a form of Pyramidellidæ separated by P. P. Carpenter from *Turbonilla* on account of their convex whorls. At Takano-Sima, on the East coast of Nippon, I afterwards discovered the animal of my genus *Fenella* (by mistake printed *Finella* in the 'Annals' for 1860), and found it to possess all the characters of a Rissoid. A comparison of my *Dunkeria* and *Fenella pupoides* has convinced me that they all belong to the same Rissoid group.

The species I examined was the original type, *Fenella pupoides*, A. Ad. It occurred in tolerable abundance on a sandy-mud bottom, in 2 fathoms water, at Takano-Sima. The head is broad, dilated, and flattened; the muzzle large, long, annular, and of a pale brown colour, edged with white. The tentacles are small, filiform, wide apart, and of an opaque-white colour. The eyes are small, black, and sessile, in the centre of white spaces on the sides of the head, behind the bases of the tentacles. The foot is

long and narrow, truncate in front, with parallel sides, pointed behind, and entirely of a white colour. It swims at the surface of the water, shell downwards, with great facility, and, in crawling, uses the muzzle to assist the foot.

The nearest allied genus to *Fenella* is *Alvania* of Risso, which comprises some small Rissoid shells with cancellated whorls and a marginal varix to the outer lip. The genera *Bittium*, Leach, and *Cerithiopsis*, Forbes & Hanley, also resemble *Fenella* in the turreted form of the shell; but in both those groups the aperture is emarginate in front. The genus is dedicated to one of Sir Walter Scott's heroines (*vide* 'Peveril of the Peak').

Genus *FENELLA*, A. Adams.

An. capite proboscidiiformi. Rostrum elongatum, cylindricum, annulatum. Tentacula filiformia, distantia. Oculi sessiles, parvi, in areolis albidis ad lateribus capitis, pone basin tentaculorum, positi. Pes elongatus, angustus, antice truncatus, postice acuminatus. Operculum corneum, subspirale.

Testa turrata, subulata seu pupoidea, imperforata; anfractibus decussatis seu cancellatis. Apertura ovali, antice integra; peritremate interrupto; labro simplici, acuto, non reflexo, incrassato aut varicoso.

1. *Fenella pupoides*, A. Ad.

Ann. & Mag. Nat. Hist. 1860.

Hab. Takano-Sima : Tsu-Sima : Yobuko : Seto-Uchi.

2. *Fenella asperulata*, A. Ad.

Dunkeria asperulata, A. Ad., Annals, 1860.

Hab. Mino-Sima : Gotto Islands ; 48 fathoms.

3. *Fenella pulchella*, A. Ad.

Dunkeria pulchella, A. Ad., Annals, 1860.

Hab. Mino-Sima ; 63 fathoms : Gotto ; 48 fathoms.

4. *Fenella fusca*, A. Ad.

Dunkeria fusca, A. Ad., Annals, 1860.

Hab. Sea of Okhotsk : Rifunsiri : Mososeki.

5. *Fenella ferruginea*, A. Ad.

Dunkeria ferruginea, A. Ad., Annals, 1860.

Hab. Sado, 48 fathoms.

6. *Fenella scabra*, A. Ad.

Dunkeria scabra, Annals, 1860.

Hab. Kino-O-Sima : Bingo-Nada : Tsu-Sima.

7. *Fenella reticulata*, A. Ad.*Dunkeria reticulata*, A. Ad., Annals, 1860.*Hab.* Awa-Sima ; in shell-sand.8. *Fenella craticulata*, A. Ad.*Dunkeria craticulata*, Annals, 1860.*Hab.* Gotto Islands ; 48 fathoms : Mino-Sima ; 63 fathoms.9. *Fenella rufocincta*, A. Ad.*Dunkeria rufocincta*, A. Ad., Annals, 1860.*Hab.* Mososeki : Takano-Sima : Tanabe.V.—*Observations on Raphides.* By GEORGE GULLIVER, F.R.S.

[Continued from vol. xii. p. 447.]

Raphis-bearing Orders.—Of British plants we have already shown that there are many orders, as Rubiaceæ, Balsaminaceæ, and Onagraceæ, which are truly raphis-bearing ; and an examination of a few exotic species has confirmed the propriety of this character. We have also proved that, in typical plants of this kind, the formation of raphides is a constant, fundamental, essential, and intrinsic result of the vigorous plant-life ; and that they are, throughout its existence, so truly part and parcel of its very nature, that we find them abundantly from the ovule to the seed-leaves and thence through all the stages of the plant-growth to the ripe fruit—in short, from the cradle to the grave of the species. And hence, independently of the value of the facts in other respects, raphides may in some instances afford a more certain and useful diagnosis than any other single one which has yet been employed in systematic botany.

While such raphidiferous orders may be closely surrounded, in the natural arrangement, by other orders destitute of raphides, there are, conversely, orders not affording raphides, and yet standing between orders which are regular raphis-bearers. Thus, Hydrocharidaceæ, an order not characterized by raphides, is immediately preceded and succeeded, in Professor Babington's 'Manual of British Botany,' by Dioscoreaceæ and Orchidaceæ—two orders which abound in raphides. Again, *Alisma* and every species which I have examined of *Potamogeton* are devoid of raphides, while all the British orders placed between Alismaceæ and Potamogetonaceæ are remarkably raphidiferous ; and numerous other instructive examples of the like kind might be given.

Surely all these facts amount to an accumulation of evidence,

not only of the importance of raphides, but that they have been hitherto strangely neglected in systematic botany. Indeed they afford such a weighty and essential natural character, often available when all other diagnostics are utterly inapplicable, and so truly expressive of the intimate economy of the plant, that it must henceforth claim an eminent place in the descriptions of any flora, and still more so in every true history of the vegetable kingdom.

Liliaceæ.—But very extensive observations are yet wanting to enable us to define peremptorily the distribution and exact value of raphides in this point of view; for though we have seen that, as far as regards the British plants yet examined, certain orders are as constantly raphidiferous as others are not so, there are still different orders, some of the members of which produce raphides regularly and abundantly, and others either irregularly, scantily, or not at all. Thus, of the order *Liliaceæ*, some of the species abound in raphides, and others are devoid of them. In the following examples, careful examinations were made, and they are confined, in this paper, when not otherwise expressed, to the leaves, for the sake of equal comparison. Raphides were not found in *Tulipa sylvestris*, *Fritillaria Meleagris*, *Lilium Martagon*, *L. candidum*, *L. aurantium*, *Allium Schænoprasum*, *A. ursinum*, *A. Ceba*, and *A. Moly*; while raphides were always found in *Ornithogalum umbellatum*, *Scilla verna*, *S. peruviana*, *Endymion nutans*, *Muscari racemosum*, *Tritoma media*, and several species of *Yucca*.

Such an irregular distribution of raphides in the members of one order might lead us to suppose that the fact must be connected either with season, climate, or soil,—which, I believe, is not entirely the case, because in some (though not all) of the species mentioned the constancy of the results was verified under many such conditions. Several of the plants were examined more than once from various localities, and during different seasons and years; while *Allium ursinum* and *Ornithogalum umbellatum* were particularly made the subjects of repeated and protracted observations, and always with the same results of no raphides in the former and an abundance of them in the latter species. Besides, any true raphidiferous plants, as *Epilobium* and many others, will always be found abounding in raphides; while, on the contrary, there are many entire orders which I have repeatedly searched in vain for raphides. In fact, this presence or absence of raphides is alone a sufficient diagnosis between some species of the order *Liliaceæ*. It will probably be objected that the Onion, now marked as a plant not characterized as raphidiferous, is the very one so often given by botanical writers as an example of a raphis-bearing species. But the crystals which have been

found in its bulb differ from raphides; and endless confusion will continue unless we restrict this term, as proposed in the 'Annals' for September last. The distinctive characters also of the larger crystal prisms, which sometimes, as in *Yucca*, occur in the same leaf with regular raphides, should not be overlooked.

Dioscoreaceæ.—In the fleshy root of *Dioscorea Batatas* (the only part of this plant which I have yet examined) raphides are very abundant. We have before seen how truly *Tamus communis* is a raphidiferous plant. It is a very good example of the constancy of this character, as I have found from many observations, under widely different circumstances, of the stem, leaves, perianth, stamens, and berry. Recently I have examined its yam-like root and young subterranean stem-shoots, and found them all equally rich in raphides. So large and distinct are they in the root, and contrast so remarkably with the starch-granules of which it is chiefly made up, that a more beautiful microscopic object of the kind could not easily be found.

Bromeliaceæ.—Raphides plentiful in the fruit and crown-leaves of the pine-apple (*Ananassa sativa*).

Musaceæ.—In the outer part of the rind of the Banana-fruit (*Musa paradisiaca*?) raphides are numerous, but not so in the pulp.

Edenbridge, Dec. 2, 1863.

[To be continued.]

VI.—Contributions to an Insect Fauna of the Amazon Valley.

COLEOPTERA : LONGICORNES. By H. W. BATES, Esq.

[Continued from vol. xii. p. 381.]

Genus BARYSSINUS, nov. gen.

Body oblong, convex. Antennæ stout, furnished sparingly with setæ beneath. Thorax somewhat short and broad, widening from the front to the tips of the lateral spines, which are very thick, and placed near to the hind angles. Elytra furnished with centro-basal tubercles, surmounted each by a pencil of hairs; the rest of their surface naked; apices scarcely perceptibly truncated. Apical abdominal segments in the male short and obtuse, in the female slightly prolonged, so as to form a short sheath for the ovipositor, the dorsal plate being flattened and obtuse, the ventral bluntly truncated. Mesosternum depressed, not tuberculated. Legs stout; thighs clavate; basal joint of the tarsi short, not surpassing in length the second and third taken together.

This genus, which comprises a few small species resembling

Trypanidius in facies, has some affinity with *Leptostylus*. We are therefore, after pursuing the line of affinities which leads through a series of depressed forms of Leiopodinæ from *Alcidion* to *Paræcus*, brought back again to the starting-point,—the present genus commencing a suite of genera of more convex form of body. The presence of hairy-crested centro-basal ridges or tubercles distinguishes *Baryssinus* from all the genera which follow, whilst the existence of a prominent ovipositor in the females, and the shape of the thorax, with the position of its lateral spines, separate it from *Leptostylus* and the allied groups.

1. *Baryssinus penicillatus*, n. sp.

B. oblongus, cinereo-brunneus, fusco obscure variegatus: thoracis dorso antice tumido: elytris utrinque tricostatis, apice rotundatis. Long. 4 lin. ♂.

Head ash-coloured. Antennæ stout, one and a half times the length of the body (♂), stout, setose beneath, ashy testaceous, tips of the joints (from the third) dusky. Thorax with the anterior part of its disk rising into a large obtusely conical elevation; lateral spines stout and curving posteriorly; surface ashy brown, with indistinct darker brown markings. Elytra oblong-quadrate, being but slightly narrowed to the tips, which are broadly rounded; the disk of each has three faintly marked ribs which do not reach either the base or the apex; centro-basal tubercles each with a thin pencil of black hairs; surface, to the tips, covered with largish punctures, ashy brown, with blackish-brown markings, which form two fasciæ beyond the middle, the anterior one oblique, the posterior one forming a curve on each elytron. Body beneath ashy. Legs pale reddish, clothed with tomentum, which forms rings alternately of an ashy and brown hue.

Beaten from dead branches; woods near Santarem.

2. *Baryssinus bilineatus*, n. sp.

B. oblongus, rufescenti-brunneus, cano fuscoque variegatus: thorace nigro bivittato: elytris apice breviter obtuse truncatis, pone medium vittis duabus abbreviatis nigris. Long. 4½ lin. ♀.

Head ash-coloured. Antennæ twice the length of the body (♀), setose beneath, ashy reddish, with the tips of the joints (including the first) blackish. Thorax regularly and moderately convex; hind margin with a single row of punctures; surface smooth, and ornamented with two blackish stripes, a line of the same colour also encircling (above) the bases of the lateral tubercles. Elytra oblong, very slightly narrowed to the tips, which appear rounded, but are seen, on close examination, to be obtusely truncate; surface free from raised lines, with the exception of

the centro-basal ridges, which are slightly elevated, but crested with black hairs; the basal part only of the elytra is punctured; the colour is reddish brown, with a light grey tinge near the middle and apex, and a number of small blackish spots, besides a short vitta, on the disk of each behind the middle, which has at each end a whitish spot. Body beneath pale reddish, clothed with ashy-brown tomentum; legs reddish, ringed with ashy and black.

Taken at Ega, on dead branches.

Genus CHÆTANES, nov. gen.

Body oblong, convex, setose. Antennæ one and a half times the length of the body, stout, furnished with a few setæ beneath. Thorax rather narrow, widening slightly from the front; lateral spines distinct, acute, standing out from the sides, and placed at a distance from the hind angles. Elytra with centro-basal tubercles, surmounted each by a crest of hairs; the rest of the surface hispid, with tufts of short bristles and longer setæ; truncated at the tip. Legs stout; thighs abruptly clavate; basal joint of tarsi equal in length to the second and third taken together. Apical abdominal segment in the males with both dorsal and ventral plates deeply notched, the angles of the ventral plate produced into spines: ovipositor elongated in the ♀; dorsal plate acute lanceolate, ventral truncated. Mesosternum in the ♂ plane, in the ♀ tumid, as in *Trypanidius*.

The only species which I have at present seen belonging to this genus has the bulk and general form of the *Trypanidii*; but it differs from them by the presence of crested centro-basal tubercles on the elytra, and by the absence of tubercles on the mesosternum in the male sex.

Chætanes setiger, n. sp.

C. oblongo-ovatus, fuscus, fulvo cinereoque varius: antennis pedibusque squamis cinereis sparsis: elytris apice utrinque macula triangulari nigra velutina liturisque cinereis. Long. 5-6½ lin. ♂ ♀.

Head dull black, sprinkled with tawny-coloured hair-scales. Antennæ scarcely one and a half times the length of the body, even in the males, dull black, sprinkled with minute ash-coloured hair-scales; the bases of the joints (from the fourth) ashy; sparingly setose beneath, the second joint having a little tuft of stiff hairs. Thorax moderately convex, widened from the front to the bases of the lateral spines, which are small and acute, and placed at a short distance from the hind angles; the surface dull black, variegated with tawny; sides (below the spines) ashy-tawny, sprinkled with black. Elytra oblong oval, briefly and rather obliquely truncated at the apex, moderately convex; sur-

face densely clothed with short, erect, black bristles, some of which arise from a little tuft of shorter bristles; moderately punctured; centro-basal tubercles surmounted each by a rather long pencil of hairs: the colour is blackish brown, with a few tawny specks; behind the middle is a short transverse ash-coloured line crossing the suture (in some examples almost obliterated), and close to the apex on each side is a triangular velvety-black spot, notched on its inner side and margined with ashy, the sutural space between the spots being sometimes wholly ash-coloured. Body beneath and legs tawny ashy, sprinkled with black; middle of abdomen black, with edges of segments tawny. The legs are stout; the thighs clavate, the basal joint of the tarsi fully equal in length to the two following taken together.

♂ The apical ventral segment in the male is semicircularly notched, the dorsal segment briefly and obtusely notched.

♀ The apical dorsal segment in the female is much elongated, lanceolate and acute, but not keeled above; the ventral segment semitubular and truncated at the tip.

Ega and S. Paulo, Upper Amazons, on dead branches in the forest. I have a specimen also from the interior of French Guiana, collected by M. Bar.

Genus *ATRYPANUS*, nov. gen.

Body oblong-oval or elliptical, convex. Head with the front elongated; eyes oblong. Antennæ not much longer than the body, and nearly naked. Thorax as in *Trypanidius*—namely, slightly uneven on the surface, widening from the front to the tips of the lateral spines—which are short, conical, and acute, not curved posteriorly, and placed not much after the middle of the thorax. Elytra with centro-basal ridges not conspicuous; obtuse at the tip, naked. Feet very stout; thighs strongly clavate; basal joint of the tarsi short, scarcely longer than the second. Mesosternum simple. Dorsal and ventral plates of the apical abdominal segment obtuse in the male: ovipositor in the female very short, scarcely apparent beyond the tips of the elytra, the dorsal plate broadly rounded at the tip, the ventral truncated.

The present genus is founded on *Lamia conspersa* of Germar, a species which differs from all the allied genera, except *Trypanidius*, in the shortness of the basal joint of the tarsi. The obtuseness of the apical abdominal segment in both sexes, the shortness of the ovipositor in the female, and the elongation of the eyes and forehead, also distinguish it from most of the groups to which it is in other respects most nearly related. It differs from *Trypanidius* (besides the elongation of the eyes) in the

mesosternum being plane instead of tumid, and also in the style of coloration, although agreeing in general form as well as in the shape of the tarsi. The genus *Trypanidius* is unknown in the Amazons region.

Atrypanius conspersus, Germar.

Lamia conspersa, Germar, Ins. Spec. nov. p. 474.

A. ellipticus, griseus, carneo nigroque conspersus : capite carneo-fulvo, fronte grisea : elytris plaga irregulari pone medium alteraque apicali griseis nigro maculatis, apice breviter oblique truncatis. Long. 4-6 lin. ♂ ♀.

The species has a wide range, being found near Rio Janeiro, on the Upper Amazons, and in Mexico. I see no difference in specimens which I have compared from all these widely distant countries.

Genus *PROBATUS* (Dej. Cat.), Thomson.

Thomson, Classif. des Cérambyc. p. 16.

Body elliptical. Antennæ scarcely one and a half times the length of the body, furnished with short stiff hairs, some of which are arranged in whorls around the tips of the joints. Thorax slightly convex, its outline curvilinearly widening from the front to the tips of the lateral spines, which are placed near the hind angles : ovipositor not produced in the females ; terminal dorsal plate truncate and bidentate in both sexes ; corresponding ventral plate obtuse, and, in the females, slightly notched. Elytra setose, even, briefly truncated and generally spined at the apex. Legs moderate ; thighs clavate ; tarsi short ; basal joint of the hind foot about as long as the two following taken together.

This is one of the best-defined and most homogeneous genera in the host of variable forms constituting the group *Leiodinae*. The character drawn from the apical abdominal segment is seen to be constant here, bringing together species agreeing in facies and many other points, but greatly diversified in colours and markings.

1. *Probatius Chryseis*, n. sp.

P. ellipticus : capite thoraceque auratis : elytris viridibus sericeis, nigro setosis, apice mucronatis ; abdomine testaceo-rufo. Long. 5-6 lin. ♂ ♀.

Head and thorax shagreened, of a rich golden colour shading into green with the play of light, naked. Antennæ black, setose ; thoracic spines large, acute, pointing obliquely rearwards, and placed very near to the hind angles. Elytra of a breadth nearly equal to three-fourths their length, thence narrowing to the apex, which, in each elytron, is prolonged into an acute spine ;

surface clothed with minute silky-green scales, and having a well-marked sutural stria with regular rows of black bristles, each proceeding from a puncture. Sides of breast rich golden green; sternum clothed with hoary tomentum; abdomen reddish testaceous, clothed (especially towards the base) with hoary pile. Legs black; thighs beneath hoary.

♂ Apical abdominal segment much longer than the medial segments; ventral plate obtuse at the tip; dorsal plate square, with the angles each produced into a stout tooth.

♀ Apical abdominal segment of the same relative length as in the ♂, but the ventral plate more convex; dorsal plate narrowed towards the tip, and terminating in two stout teeth.

One pair, taken in *copuld* on a dead branch, at Obydos, on the Guiana side of the Lower Amazons. The insect has a deceptive resemblance to species of the Cerambycoid genus *Chrysopraxis*, found in the same localities.

2. *Probatius humeralis*, Perty.

Acanthocinus humeralis, Perty, *Delectus Anim. Art. Itin.* Spix & Martius, p. 91, pl. 18. fig. 8.

P. oblongus, fusco-niger, sericeus: thoracis vitta centrali, scutello, macula elytrorum utrinque humerum circumdante lineaque abbreviata marginali aurantiacis. Long. $4\frac{1}{2}$ lin. ♂ ♀.

The apical abdominal segment is of nearly the same shape in both sexes as in *P. Chryseis*; but the ventral plate in the ♀ is briefly notched at the apex.

This species has a wide range. I have specimens before me from Rio Janeiro, the Upper Amazons, and Cayenne. It is also found in Mexico, but exists there under the form of a well-marked local variety or race, the *P. mexicanus* of Thomson (*Classif. des Céramb.* p. 17). This differs from the South-American form by the orange-coloured marginal streak extending to the tip of the elytra, instead of halting halfway, and by the thoracic vitta extending over the crown of the head.

3. *Probatius partitus*, White.

P. ellipticus: capite, thorace (brunneo indistincte bivittato) articuloque basali antennarum testaceo-ochraceis: elytris postice valde attenuatis, nigris, nitidis, basi obscure testaceis, maculis minutis griseis in fasciis undulatis tribus dispositis, nigro setosis, striatopunctatis, postice unicarinatis. Long. $4-4\frac{1}{2}$ lin.

The apical abdominal segment is of a similar form in both sexes to that of *P. Chryseis*. The antennæ, excepting the pale basal joint, are black, with the bases of the joints whitish. The thoracic spines are thick, conical, and obtuse. The apical spines

of the elytra are very long and acute, the smooth posterior carinæ of the wing-cases continuing to their tips.

Found at Pará, on dead boughs in the forest. It has also been found by M. Bar in the interior of French Guiana, specimens collected by that gentleman having been sent to me from Paris under the MS. name of *P. ruficollis*.

4. *Probatius apicalis*, n. sp.

P. oblongo-ovatus, fusco-niger, sordide ochraceo canoque variegatus; thorace ochraceo nebuloso, medio fusco bivittato: elytris postice modice attenuatis, apice transverse sinuato-truncatis, angulis externis longe spinosis, dorso punctis setiferis in striis dispositis, dimidio basali maculaque apicali ochraceis nigro conspersis, fascia lata pone medium fusco-nigra lineolis canis variegata: antennis fusco-nigris, infra dense setosis, articulo quarto annulo lato pallido. Long. $4\frac{3}{4}$ lin. ♂ ♀.

Head dingy ochraceous; vertex with two divergent blackish vittæ. Antennæ black; basal joint dingy rufous, second and base of third joints hoary, basal half of fourth whitish; they are furnished with long setæ, the first joint being fringed beneath with them. Thorax dingy ochraceous, partly lighter and partly darker in hue, the centre having two nearly parallel, distinct, dark-brown vittæ; the lateral spines are large, conical, simply acute, and not prolonged at their points. Elytra gradually and moderately narrowed to their tips, which latter are transversely sinuate-truncate, the sutural angle of the truncature being advanced but obtuse, the external angle prolonged into a stout spine; the posterior carina, which in *P. partitus* is very long, is here reduced to a faint elevation close to the tip of each elytron, and the sutural stria is not strongly impressed; the surface has many rows of setiferous punctures; the basal half is dingy ochraceous, much speckled with black; the apical part has an ochraceous patch neatly limited on its anterior edge, and varied with dusky points, the extreme apex near the suture having a smaller opaque ochreous spot; the rest of the elytra is dull blackish, which colour forms a broad fascia, varied only by minute grey linear specks, arranged in lines. Body beneath and legs dingy ashy; tarsi pale testaceous; apical segment of abdomen black; ventral plate obtuse, dorsal plate truncate and bidentate in both sexes.

This was rather a common insect at Ega, on branches of dead trees in the forest.

5. *Probatius ramulorum*, n. sp.

P. ellipticus, fusco-niger, fulvo-ochraceo variegatus: thorace dorso nigro, lineis duabus ochraceis antice convergentibus: elytris fusco-nigris, maculis ochraceis conspersis et fasciatis, apice oblique truncatis. *Ann. & Mag. N. Hist. Ser. 3. Vol. xiii.* 4

catia, angulis externis vix dentatis: antennis nigris, infra paros setosis, articulo quarto basi pallido. Long. $4\frac{1}{2}$ lin.

Head tawny ochraceous, vertex with two oblique flexuous dusky lines. Antennæ black, two basal joints dingy ochraceous, fourth with the basal third of its length pale testaceous; they are setose, but the basal joint beneath is free from setæ. Thorax on the sides tawny ochraceous, the middle blackish, with two oblique S-shaped streaks converging in front on the fore part of the disk; the dorsal line is also dotted with ochraceous. Elytra strongly narrowed towards the tip, which is not spined, but obliquely truncated, with the sutural angle rounded off and the external one simply acute; the surface is furnished with rows of setiferous punctures; there is no posterior carina, and the colour is shining brown-black, with a sprinkling of tawny specks, some of which collect to form two indistinct narrow fasciæ, one near the middle, the other near the apex. Body beneath dusky, with dingy ashy pile; margins of ventral segments whitish. Legs blackish; claw-joints of the tarsi testaceous. The apical dorsal plate has shortish and rather blunt teeth.

Valley of the Irurá, Santarem; on dead boughs.

Genus OXATHRES, nov. gen.

Body elliptical, moderately convex, setose. Antennæ furnished with numerous setæ. Thorax as in *Probatius*, its outline widening from the front to the tips of the lateral spines, which are small, conical, and placed behind the middle. Abdomen in the male with the apical dorsal plate notched or entire; ventral plate truncated and terminating in two stout teeth, like the dorsal plate of *Probatius*. In the female the apical abdominal segment is prolonged as a conical or short tubular sheath to the ovipositor, the dorsal plate tapering into a very sharp point, and in some species acutely carinated on its upper surface; the ventral plate is simply truncated in the female. Legs moderately short and stout; thighs abruptly clavate; tarsi short, even in the hind legs, much shorter than the tibiæ, but the first joint slender and longer than the two following taken together.

This genus, although closely allied to *Probatius*, is distinguished at once by the bidentation of the apex of the abdomen existing on the ventral instead of the dorsal plate; but this is seen in the males only, the females differing from the same sex in *Probatius* still more widely—namely, by having an exerted ovipositor and a prolonged pointed dorsal plate, instead of a bidentated one.

1. *Oxathres navicula*, n. sp.

O. ellipticus, rufescenti-fuscus vel obscure fuscus: thorace dorso

convexo, lævi, spinis lateralibus brevibus conicis mox pone medium sitis: elytris granulato-punctatis, lineis interruptis cinereis apice peroblique truncatis, angulis interioribus obtusis, externis subacutis. Long. $3\frac{1}{4}$ lin. ♂ ♀.

Head dusky. Antennæ reddish, with a few short stiff hairs both above and beneath the joints, especially at their apices. Thorax convex, smooth, reddish brown, sometimes with a faint ashy vitta on each side, the lateral spines forming simply conical protuberances on the sides, a little behind the middle. Elytra strongly narrowed posteriorly in the ♂, more ovate in the ♀, obliquely and obtusely truncated at the tips; surface with numerous punctures, each surmounted by a raised point, dull reddish or dark brown, with scanty ashy pubescence arranged partly in interrupted lines. Body beneath and legs dull reddish brown or blackish, shining, scantily clothed with ashy pile; legs hirsute; basal joint of the hind tarsi as long as the three remaining joints taken together.

♂ The apical abdominal segment in the ♂ is greatly elongated, at least the ventral plate, with the angles of the apex acute; the dorsal plate is much shorter and deeply notched.

♀ The ovipositor projects beyond the tips of the elytra; apical dorsal plate with raised margins and a sharp keel running into a prolonged point.

Pará and Santarem, on slender dead branches.

2. *Oxathres Erotylroides*, n. sp.

O. ellipticus, flavo-testaceus: elytris cinereis, utrinque nigro decem-maculatis. Long. $4\frac{1}{4}$ lin. ♂.

Head testaceous yellow, with golden-yellow pile. Antennæ black, with three white rings, sparingly clothed with long setæ. Thorax small, yellow-testaceous; lateral spines forming simply conical protuberances on the sides, a little behind the middle. Elytra of equal breadth to about three-fourths of their length, thence rapidly narrowing to their tips, which latter are briefly and rather obliquely truncated, the sutural angle of the truncature rounded off, the external one produced into a short blunt tooth directed outwards; surface densely clothed with dusky setæ and punctured, with an obtuse smooth posterior carina on each side running into the apical tooth. The colour is ashy, with, on each elytron, ten rounded black spots—namely, three on the margin near the shoulders, four in a line parallel to and near the suture, and three on the disk. Body beneath and legs yellow-testaceous; basal joint of tarsi equal in length to the two following taken together. Apical dorsal plate of the abdomen (♂) rounded and closely applied to the ventral plate, which is truncated and strongly bidentate.

I found only one example of this singularly coloured species. It was met with at Ega, on an old stump in the forest, and was mistaken at first for an *Erotylien*, especially a species of *Priotelus*, which is almost identical in colours with this Longicorn, and which was often seen in similar places when the fallen trees were covered by fungi.

3. *Oxathres muscosus*, n. sp.

O. oblongus, cinereo-olivaceus, nigro conspersus: antennis, pedibus elytrisque longe setosis, his apice sinuato-truncatis, angulis externis breviter mucronatis. Long. $2\frac{1}{2}$ – $2\frac{3}{4}$ lin. ♀.

Head olivaceous, vertex with two dusky spots. Antennæ with all the joints except the basal one furnished with a few longish and straight bristles, placed both above and beneath; they are blackish in colour, with the bases of the joints (from the fourth) pallid. Thorax rather narrow; lateral spines thick, conical, and placed near the hind angles; surface olivaceous, with dusky marks and four rather darker spots on the disk. Elytra oblong, apex sinuate-truncate; sutural angle obtuse, external one produced into a short tooth; surface clothed with long black bristles, punctured towards the base, partly in lines, ashy olivaceous, with numerous black spots, some of which are united near the middle and form an imperfect flexuous belt. Body beneath ashy. Legs hirsute, dingy ashy; tarsi reddish testaceous.

♀ Apical abdominal segment with the dorsal plate lanceolate, the point prolonged and acute; ventral plate simply truncated.

Ega; on dead branches in the forest.

Genus TRICHONIUS, nov. gen.

Body oblong, setose. Antennæ about twice the length of the body in both sexes, furnished with numerous longish setæ. Thorax broad, widening in a curved line from the front to the tips of the lateral spines, which form thick conical protuberances situated near to the hind angles. Elytra setose, not much narrowed behind, with their tips obtusely truncated or rounded. Legs stout, bristly; thighs clavate; tarsi much shorter than the tibiæ, but the basal joint slender and elongated. Apical abdominal segment in ♂ not elongated, with tips of both dorsal and ventral plates broadly rounded; in ♀ slightly prolonged as a sheath to the very short ovipositor, which scarcely passes the tips of the elytra; its dorsal plate flattened and rounded at the tip, its ventral plate truncated.

In the shape of the thorax and setose clothing of the body and limbs this genus resembles *Probatius* and *Oxathres*. It differs from both in the obtuse apices of the ventral and dorsal plates of the terminal abdominal segment in both sexes. There is a

somewhat close relationship between *Trichonius* and *Barysinus*, but this latter genus is amply distinguished by its crested centro-basal tubercles.

1. *Trichonius quadrivittatus*, n. sp.

T. oblongus, subdepressus : thorace lato, cinereo, fusco quadrivittato : elytris apice obtuse breviter truncatis, cinereis, fusco multiguttatis. Long. $3\frac{1}{2}$ lin. ♀.

Head brownish ashy, vertex with two fuscous dots. Antennæ more than twice the length of the body, bristly both above and beneath, reddish, bases of the joints from the fourth pallid. Thorax short and broad; lateral spines conical, scarcely pointed, and placed very near to the hind angles; surface smooth, brownish ashy, darker in the middle, and with four distinct dark-brown stripes, besides one less distinct on each side below the lateral spines. Elytra rather depressed, slightly narrowed behind, obliquely and very obtusely truncated at the tips, clothed with long bristles, which arise from punctures placed in rows independent of smaller punctures lying rather thickly towards the base; brownish ashy in colour, with a large number of small dark-brown spots which cover the setiferous punctures. Body beneath and legs dingy ashy, the latter bristly.

Villa Nova; on dead branches.

2. *Trichonius fasciatus*, n. sp.

T. oblongus, subdepressus : thorace cinereo, fusco bivittato : elytris apice truncatis, angulis exterioribus prominentibus, cinereis, pone medium fusco fasciatis. Long. $3\frac{1}{2}$ lin. ♀.

Head brownish ashy. Antennæ more than twice the length of the body, blackish, with the basal joint dull reddish, bristly both above and beneath; bases of the joints, from the fourth, pallid. Thorax broad; lateral spines thick, pointed, and slightly curving behind; surface smooth, brownish ashy, darker in the middle, and with two distinct dark-brown vittæ, besides two dusky spots on each side above the lateral spines. Elytra rather depressed, very slightly narrowed behind, transversely truncated at the apex, with the exterior angles slightly produced; surface clothed with long bristles, which arise from punctures placed in rows independent of smaller punctures lying rather thickly towards the base; brownish ashy in colour, with a rather well-defined dark-brown fascia lying behind the middle, besides two small lateral marks of dark-brown colour, one near the base, the other near the apex. Body beneath and legs reddish testaceous, clothed with ashy down; the legs bristly and ringed with dusky.

Santarem.

3. *Trichonius picticollis*, n. sp.

T. oblongus, convexus : thorace spinis lateralibus crassis, leviter

curvatis, dorso brunneo vittis posticis duabus nigris intus albo notatis : elytris breviter setosis, brunneis, postice nigro alboque guttatis, apice rotundatis. Long. $3\frac{1}{2}$ lin. ♂.

Head dingy brown. Antennæ scarcely twice the length of the body, setose, the bristles much longer and more numerous beneath than above; reddish, tips of all the joints blackish; bases of the joints, from the fourth, pallid. Thorax broad, lateral spines very thick, large, and pointed, slightly curving and placed at a short distance from the posterior angles; surface anteriorly clear brown, posteriorly dusky, with two indistinct black vittæ not reaching the front margin, and dotted on their inner sides with whitish; there are also other white specks on the base and sides. Elytra rather more convex than in the allied species, scarce perceptibly truncated at the tips; surface clothed with shortish bristles, which are decumbent, instead of suberect as in the preceding species, and which arise from punctures placed in rows independent of the smaller irregular basal punctures; the colour is purplish brown, with a few indistinct black streaks and dots, and, behind the middle, a number of white specks. Body beneath and legs reddish, clothed with ashy pile; legs hirsute, but not bristly.

S. Paulo, Upper Amazons.

Genus *SPORETUS*, nov. gen.

Body elongate-oblong, free from inequalities on the surface. Antennæ twice the length of the body, setose both above and beneath. Thorax subquadrate, rounded on the sides, and not widened from the front, the lateral spines forming small obtuse tubercles situated some distance from the hind angles. Elytra oblong, clothed with stiff hairs, simply and briefly truncated at the tip. Thighs clavate; hind tarsi with the basal joint elongated. Apical abdominal segment with both dorsal and ventral plates notched in the male, forming a sheath to the more or less exerted ovipositor in the female, the dorsal plate of which is pointed, the ventral truncate.

The few species combined to form this group differ from all the other genera of setose *Leiopodinæ* in the oblong narrow form of their bodies and the subquadrate shape of the thorax, with the shortness of its lateral spines. In colour they are either blackish with ashy spots, or grey sprinkled with blackish.

§ 1. Ovipositor of the ♀ short, scarcely apparent beyond the tips of the elytra (*Chætissus*).

1. *Sporetus* (*Chætissus*) *porcinus*, n. sp.

S. elongatus, hirsutus, griseus, fusco conspersus : capite thoraceque elytris angustioribus. Long. $2\frac{1}{2}$ lin. ♀.

Head dull greyish. Antennæ brownish, with the bases of the

joints from the fourth pallid; setose both above and beneath. Thorax grey, with a few indistinct darker markings. Elytra rather wider than the head and thorax, and widened towards two-thirds their length, truncated at the apex, with both angles distinct; surface clothed with long black bristles, grey, with dusky specks lying over the setiferous punctures and arranged in lines. Body beneath and legs dull testaceous, clothed with grey pile; thighs not abruptly clubbed; tarsi very moderately elongated. Ovipositor short; apical dorsal plate of the abdomen broad at the apex, and produced into a point in the middle.

S. Paulo, Upper Amazons.

This species, in the length of the ovipositor of the female, forms a connecting link between *Sporetus* and *Trichonius*; the terminal dorsal plate, although short and broad, is pointed at the apex, and not rounded off as in *Trichonius*.

♂ 2. Ovipositor of the ♀ long, projecting to the length of a line beyond the tips of the elytra; dorsal plate tapering to a sharp point.

2. *Sporetus seminalis*, n. sp.

S. fusco-niger, cinereo conspersus: thorace medio cinereo quadriguttato, lateribus utrinque bivittatis: elytris apice albis, oblique truncatis. Long. 3-4 lin. ♂ ♀.

Head dark brown, with a central line from vertex to epistome, another on each side from the upper inner margin of the eye, and the cheeks yellowish ashy. Antennæ black, basal joint red, bases of third, fourth, sixth, eighth, tenth, and eleventh joints white; setose both above and beneath. Thorax above dark brown, the disk having four ashy dots, namely, one each on the front and hind margins, and two, smaller and more rounded, placed transversely in the middle; the sides each with two oblique ashy lines, which sometimes meet at the hind angle. Elytra with the tips truncate, both angles distinct; surface densely clothed with short stiff hairs, finely punctured, dark brown, with a large number of ashy specks, of different sizes and shapes, the extreme apex having a distinct white spot on each side. Body beneath ashy; sides of breast striped with dark brown. Legs elongated; thighs abruptly clavate, black or pitchy red, ringed with grey; basal joint of hind tarsi longer than the three remaining taken together.

Pará and Ega; not uncommon: found also at Cayenne. At Ega a strongly marked variety occurred, which merits separate name and mention:—

Var. *agglomeratus*. The ashy spots of the elytra are partly collected into large cinereous patches, one on each side, placed

transversely in the middle of the elytron, the space anterior and posterior to this large spot being nearly free from markings.

Long. 3-4 lin. ♂ ♀.

Egæ; less common than the type*.

[To be continued.]

VII.—On a new Species of Hyæna from the Red Crag of Suffolk.

By E. RAY LANKESTER.

[Plate VIII.]

MOST of the terrestrial Mammals of the Red Crag strata in England are known by few and fragmentary specimens, consisting either of teeth or portions of sea-worn jaws. The species at present recognized amount to thirteen; they are as follows, and are nearly all identical with species from Miocene beds on the continent of Europe:—*Rhinoceros Schleiermacheri*, Kaup; *Tapirus priscus*, Kaup; *Sus palæochaerus*, Kaup; *Sus antiquus*, Kaup; *Equus*, sp., Owen; *Hipparion*, sp., Owen; *Mastodon angustidens*, Owen; *Cervus dicranoceros*, Kaup; *Megaceros*, sp., Owen; *Felis pardoides*, Owen; *Pterodon*, sp., Owen; *Canis*, sp., Owen; *Ursus*, sp., Owen.

The relations of land and water at the time of the deposition of the Red Crag it is not my intention to discuss, although the presence of a Miocene land-fauna associated with marine Mollusca of an eminently arctic type may have some important bearings on that subject. Attention is merely drawn to the fact as showing the necessity of a comparison with Miocene species in attempting to identify any apparently new Mammalia from the older Crag of Suffolk.

Figs. 5, 6, 7, Pl. VIII., are drawings of a tooth belonging to a species of Hyæna which the author obtained from the Red

* The following Rio-Janeiro species belongs also to section 2 of the genus *Sporetus*. It has a strong resemblance to *Probatius ludicrus*, and is confounded with it in some collections:—

S. probatioides. Oblongus sive ellipticus, purpureo-fuscus, sericeus, cinereo maculatus. Caput fuscum, sericeum. Antennæ longissimæ, breviter setosæ, purpureo-fusæ, articulis (tribus basalibus, 7^{mo} et 9^o exceptis) basi griseis. Thorax convexus; spinis lateralibus minutis mox pone medium sitis; dorso fusco angulis et margine posticis obscure cinereo maculatis. Elytra apice subsinuato-truncata, angulis obtusis, dorso nigro-setosa, punctata, purpureo-fusca, sericea, guttis sex basalibus, maculis duabus lateralibus (una magna ante medium, altera parva pone medium) et signaturis apicalibus cinereis. Corpus subfuscum. Pedes subelongati, obscure castanei, griseo annulati, haud setosi; femoribus valde clavatis. Maris segmento apicali abdominis emarginato. Long. 4½ lin. ♂. Hab. Rio Janeiro, a Dom. Squires lecto.

Crag at Felixstowe, in Suffolk. The specimen presents that peculiar gloss on the surface and mineralized appearance which is characteristic of dental remains from this deposit. In addition to these circumstances, portions of the shelly matrix still adhere between the two fangs of the tooth; so that there can be no doubt as regards its claims to belong to the same deposit which has furnished the remains of the *Felis pardoides*, *Mastodon angustidens*, &c. The author has submitted the tooth to Dr. Falconer, who "infers it to be an upper third premolar of a species of Hyænoid animal, and probably *Hyæna*," and "would approximate it to a species of the subgenus *Crocotta*, which includes *H. spelæa* and *H. crocuta*. The fossil does not appear to belong to the Miocene *H. Hipparionum* of the Vaucluse, which is imperfectly known. Fossil Hyænas are got in the Val d'Arno (Miocene), which are not yet sufficiently made out. The above opinion is expressed with the reserve dictated by the very limited amount of the evidence—a solitary premolar."

The characters of the subgenus *Crocotta* of Kaup are the presence of spots instead of stripes on the skin, and the absence of a mane and anal pouches, which are possessed by the type of the other genus, *Hyæna striata*. The dental characters, however, form the most important distinction. In both types the formula

is, $i. \frac{2-3}{2-3}$, $c. \frac{1-1}{1-1}$, $pm. \frac{4-4}{2-2}$, $m. \frac{1-1}{0-0}$. The molar tooth is very small in

H. striata, presents a narrow oblong surface, and is inserted by two fangs. In *H. crocuta* or *Crocotta maculata* the molar is quite rudimentary, and has a circular conical crown. In *H. spelæa* it is even still smaller, and is inserted by a single process. The fourth premolar of the lower jaw further distinguishes the two subgenera—in *H. striata* a very prominent tubercle being persistently developed, which is absent in *H. crocuta* and *H. spelæa*. With regard to the third premolar of the upper jaw, which more immediately relates to the fossil under description, in *H. striata* the central cusp of the tooth (Pl. VIII. fig. 4) is less produced and less cylindrical than in *H. crocuta* or *H. spelæa*, the "cingulum" is not appreciably developed, whilst an anterior and posterior tubercle are very prominent. In *H. crocuta* and *H. spelæa*, the "cingulum" is invariably strongly marked, and is developed posteriorly so as to form an elongated ascending ridge, which is not, however, comparable to the tubercles in *H. striata*. It is not difficult thus to separate into subgenera the living and Pleistocene species; but when we go further back in time, and examine the species of older deposits, the distinctions fail, and a combination of characters is found which renders it impossible to place the Miocene and older Pliocene species of *Hyæna* in either subgenus. In fact this is what would be anti-

ipated, it being a pretty generally received axiom that the divergence of types increases as we ascend the geological ladder. The tooth from the Red Crag, which is the upper third premolar of the *left* side, is less produced in proportion to its length and breadth than the corresponding tooth of any of the other species I have been able to examine. The anteroposterior measurement is also proportionately larger than in other species. The "cingulum" is slightly developed all round the base of the crown, and posteriorly is enlarged into a very conspicuous ridge, as in *H. spelæa*, but this does not abut against the central cusp. Between the "cingulum" and cusp a small tubercle exists, which would therefore approximate it to the *H. striata* type. No anterior tubercle exists, as there does in *H. striata*, but the "cingulum" is slightly enlarged (figs. 5, 6, 7).

There appears to be no description of any species of *Hyæna* corresponding with the characters of this tooth, the specimens from the older Continental beds being, as far as I am able to judge, very different, if M. de Blainville's memoir may be relied on. I therefore, for the sake of perspicuity and convenience, propose to call this species *Hyæna antiqua*, provisionally. If at any time further material should identify it with any known species, my name must be rescinded. It rests on facts quite as characteristic and distinctive as does the *Felis pardoides* of Owen, of which we still require further evidence before affirming it positively to be distinct from the *Felis antediluviana* of Kaup, from the Miocene of Germany.

The following is the arrangement of species of *Hyæna* given by M. de Blainville, in which I have inserted the new Crag form:—

- Hyæna striata*, Zimmerm. India (living).
 Syn. H. vulgaris. H. Sivalensis?
- H. prisca*, De Serres. Caverns of Lunel-Viel.
 Syn. H. Monspensulana, Christol.
- H. arvernensis*, Croizet & Jobert. Auvergne.
- H. fusca*, Thunb. Cape (living).
- H. Perrieri*, Croizet & Jobert. Auvergne.
- H. intermedia*, De Serres. Lunel-Viel.
- H. spelæa*, Goldfuss. France, England, &c.
- H. crocuta*, Bodd. Cape (living).
- H. antiqua*, Lankester. Felixstowe, Suffolk (Red Crag).

EXPLANATION OF PLATE VIII.

- Fig. 1.* Upper third premolar tooth (left side) of *Hyæna crocuta*, Bodd.
- Fig. 2.* Ditto of *Hyæna spelæa*, Goldfuss. From Kent's Hole.
- Fig. 3.* Ditto of *Hyæna arvernensis*, Croizet & Jobert. Auvergne.

Fig. 4. Ditto of *Hyena striata*, Zimmerm.; three-quarter view, to show the anterior tubercle.

Figs. 5, 6, 7. Ditto of *Hyena antiqua*, Lankester. Red Crag, Suffolk.

Fig. 8. Ditto of *Hyena striata*, Zimmerm. View of the crown of the tooth.

Fig. 9. Ditto of *Hyena crocuta*, Bodd.

VIII.—On Species of Ostracoda new to Britain.

By GEORGE S. BRADY.

[Plates III. & IV.]

THE following species of freshwater Entomostraca have been taken during the present year in the counties of Northumberland and Durham. One of them (*Cypris affinis*) is a Continental species, not heretofore recorded as a native of Britain. The rest are now for the first time described. To these descriptions I have appended a few notes on the animal of *Cyprideis torosa* (Jones), and on its occurrence in a recent state in this district.

Fam. Cypridæ.

Subfam. 1. CYPRINÆ (Dana).

Genus CYPRIS, Müller.

Cypris oblonga, n. sp. Pl. III. figs. 1-4.

Elongate, subreniform; lower margin slightly sinuated; upper edge considerably arched, highest in the middle; extremities rounded, the posterior being the more obtuse. Seen from above, the carapace is ovoid in shape, the junction of the valves forming, toward the extremities, a well-marked keel, which is most prominent anteriorly. The valves are clothed with a few scattered hairs, and marked irregularly with one or more transparent patches, which appear light or dark according to the mode of illumination. Colour light brown. Length $\frac{1}{16}$ inch; height $\frac{1}{32}$ inch.

This species is nearly allied to *C. fusca*, which differs from it in being broader and more tumid, as well as in the surface-markings. The abdominal rami of the two species are also different, as may be best seen by a comparison of the figures (Pl. III. figs. 4 & 5). The "lucid spots" are much larger and more distinct in *C. oblonga*. It is perhaps worthy of notice that specimens of *C. fusca*, when steeped in solution of potash, impart to the liquid a beautiful purple colour. I have not noticed this with other species, but should suppose it likely to occur where a sufficiency of brown pigment exists in the shell.

Cypris oblonga was taken in a pond at Fenham, near Newcastle, in April 1863.

Cypris striolata, n. sp. Pl. III. figs. 12-17.

Valves broadly subreniform; dorsal margin greatly arched; ventral margin slightly sinuated; anterior and posterior margins obtusely rounded; the highest part of the carapace somewhat behind the middle. Viewed from above, the carapace is much compressed, and tapering toward the extremities, of which the posterior is more obtusely rounded than the anterior. Surface of the valves smooth, and regularly marked with beautifully fine, anastomosing, longitudinal striations. Colour deep brown. Length $\frac{1}{10}$ inch; height $\frac{1}{10}$ inch.

This approaches very closely to *C. compressa*; and, except in the sculpturing of the carapace (which is very well-marked and characteristic) and the sinuation of its lower margin, I cannot find any feature which distinctly separates it from that species. The valves of *C. compressa* are more or less deeply *pitted*; and in no instance have I been able to find any trace of the striation which distinguishes the present species. The general contour of *C. striolata* is more nearly reniform, the lower edge being decidedly sinuated, and the extremities are not quite so abruptly rounded. It is also larger than *C. compressa*.

Habitat. Broomley Lough, Northumberland. April 1863.

Cypris affinis, Fischer. Pl. III. figs. 6-11.

Cypris affinis, Fischer, Mémoires des Savants Etrangers, St. Petersburg, vol. vii. p. 146, pl. 4. f. 1-11; Lilljeborg, De Crust. ex ord. tribus Cladocera, Ostracoda, et Copepoda in Scania occurrentibus, p. 116, pl. 11. f. 8-14.

Valves elongated, broad anteriorly; upper margin arched, highest a little in front of the centre, and with a slight gibbosity, from which it slopes gently backward; inferior margin sinuated; extremities rounded, the posterior being much the narrowest. Valves sculptured with a reticulated pattern, giving somewhat a scaly appearance to the surface. Seen from above, the carapace is broadly oval in form, with pointed extremities. Colour olive-grey or brown. Length $\frac{1}{10}$ inch; height $\frac{1}{10}$ inch.

This species is easily distinguished by the peculiar sculpturing of the valves, which, in fine specimens and with good illumination under the microscope, resembles an exquisitely wrought pattern of silver filagree-work. The reticulations of which the ornament is composed are largest toward the extremities of the valves: across the middle of the carapace they are not very conspicuous, as the shell-structure is there more condensed. The junction of the open work of the extremities with that of the closer central band is shown in Pl. III. fig. 7. It will be seen

that, though very much compressed, the tendency to a radiate arrangement of the lacunæ (?) is continuous throughout.

I first found this species in a pond at Fenham, near Newcastle, in April of the present year; and it has since been taken by the Rev. A. M. Norman in two ponds near Sedgely, county Durham, and again by myself near Whitburn, in the same county.

Genus CANDONA, Baird.

Candona virescens, n. sp. Pl. IV. figs. 1-5.

Carapace elongated, compressed, rather higher in front than behind; ventral margin slightly sinuated; dorsal margin very gently arched; anterior and posterior margins rounded. Surface of the valves smooth. Seen from above, the carapace is compressed, widest in the middle, and tapering gradually toward the extremities. Colour a delicate sea-green, irregularly variegated with markings of a lighter hue. Filaments of superior antenna five long and seven short. Length $1\frac{3}{8}$ inch; height $\frac{1}{4}$ inch.

This species was found in considerable abundance in a shallow weedy pond at Ashburn, near Sunderland, in May 1863. In shape it closely resembles Dr. Baird's figures of *C. similis*; and some specimens have, when fresh, two dark spots, which however disappear on drying: they seem to correspond with the eye- and muscle-spots. When I first found my specimens, I supposed that they might prove to be merely the young of *C. reptans*, as they are not unlike in shape to that species, though much paler in colour. But the absence of any brush of setæ on the lower antenna is of itself a sufficient character to separate the two species. I find that even the very youngest specimens of *C. reptans* possess these setæ quite distinctly developed.

Candona albicans, n. sp. Pl. IV. figs. 6-10.

Valves oblong. Dorsal margin straight, curving abruptly at the posterior extremity, and more gradually in front; ventral margin deeply sinuated; extremities obtusely rounded off. Surface of the valves uniformly and closely punctated, with a few scattered slender hairs round the anterior and posterior margins. Seen from below, the carapace is flattened, ovate, and produced into a fillet at the anterior extremity. Colour opake white, uniform or with pellucid patches. Length $1\frac{3}{8}$ inch; height $\frac{1}{4}$ inch.

I took a single specimen of *C. albicans* (from which the accompanying drawings were made) in fresh water near Sunderland, in 1861. It has been found plentifully this year, in a

small grassy pond near Sedgefield, by the Rev. A. M. Norman, in company with *C. lucens*, *Cypris tristriata*, *C. affinis*, *C. ovum*, &c. With reference to his specimens, Mr. Norman remarks: "This species approaches very near to *C. lactea* (Baird), but is wider in proportion to its length, is not so ventricose, and wants the conspicuous encircling fillet of that species. The surface in *C. albicans* is excavated with very numerous, small, shallow pits; but in *C. lactea* it is only sparingly and finely punctate."

Subgenus CYPRIDEIS, Jones.

Cyprideis torosa, Jones. Pl. IV. figs. 11-23.

Cyprideis torosa, Jones, Entomostraca of the Tertiary Formation of England, 1856, p. 21, pl. 2. figs. 1 a-1 i, and woodcut, fig. 2, p. 16.

Candonia torosa, Jones, Ann. & Mag. Nat. Hist. ser. 2, 1850, vi. p. 27, pl. 3. fig. 6.

Valves oblong, convex, somewhat broader in front than behind. Ventral margin straight, or with a *very slight* sinuation, mostly furnished with a single stout spine at the posterior angle; dorsal margin arched, higher anteriorly. Hinge-margin of the right valve bearing a series of corrugations or elongated tubercles, which are received into corresponding depressions of the opposite valve. Extremities obtusely rounded. The right valve is smaller than the left, and has the dorsal margin inclined more steeply, and almost in a right line, from before backwards. "Surface of the valves marked with closely set angular pittings," and with a more or less conspicuous transverse sulcus somewhat in front of the centre. Young specimens are sometimes furnished also with a few short, thinly scattered hairs, and at the postero-inferior angle, near the spine before mentioned, there is often a conspicuous group of rather long hairs. Lucid spots arranged in a transverse row of about four near the sulcus. Dorsal aspect ovate, irregularly and obsoletely angular. Length $1\frac{2}{3}$ inch; height $1\frac{2}{3}$ inch.

The occurrence of this species in a recent state was first mentioned by Professor T. Rupert Jones (*loc. cit.*), who obtained it from ditches of brackish water at Gravesend, and who has kindly supplied me with specimens from that locality for examination. These ditches are now, I believe, nearly silted up with mud and decomposing matter. It has also been taken by the Rev. A. M. Norman on the sands at Weston-super-Mare, to which position it had probably been washed by the Uphill River. Mr. Norman has recently taken it in fresh water in the "Forge Dam," Sedgefield, and in immense profusion in brackish water at Hartlepool. Lastly, I have myself found it in extraordinary numbers in estuarine pools at Warkworth.

The following table indicates the Crustacea with which *C. torosa* was found associated in the localities above specified :—

Sedgefield. (fresh water).	Gravesend. (brackish).	Hartlepool. (brackish).	Warkworth. (brackish).
Cypris ovum. — gibba. — punctillata. Candona serrata — reptans &c. &c.	Crangon vulgaris. Cypris gibba. — aculeata. Candona lucens.	Palæmon varians.	Crangon vulgaris. Gammarus locusta.

The animal of *C. torosa* differs only very slightly from that of the genus *Cythere*. The limbs (except the first pair of legs, of which, owing to their minute size, I have not been able to obtain a satisfactory drawing) are represented in Pl. IV. figs. 11–15. The only characters by which I can distinguish them from the limbs of *Cythere* are the absence, from the second joint of the inferior antenna, of the long stout seta which is always found in that genus, and the presence, on the coxæ of the last pair of legs, of four or five rows of long hairs having apparently a semiverticillate arrangement. The tufts of bristles which occur in other situations are similar in disposition to those of *Cythere*. Some of the longer setæ or hairs are terminated with a peculiar ringed and serrated armature, which is shown at fig. 15. This character is always confined to certain hairs, which are constant in position, and is found likewise in *Cythere*. I have not been able, in my recent specimens of *C. torosa*, to detect the regular tuberculation figured and described by Mr. Jones : but there is much difference in the various specimens, according to age and locality ; and it is evident that considerable latitude must be allowed in this as well as in the spinous armature of the carapace. In comparatively few of the Gravesend specimens have I found any appearance of the single spine, while in those from Warkworth it is almost constant. I have frequently, in examining *C. torosa*, found the carapace almost filled posteriorly with a very large mass of ova. This fully accounts for the prodigious quantities in which the species is found in favourable localities, such as those at Hartlepool and Warkworth, and is the more remarkable, as in *Cythere*, so far as I have observed, the ova are very few in number.

Sunderland, Nov. 23, 1863.

EXPLANATION OF THE PLATES.

PLATE III.

Fig. 1. *Cypris oblonga* (Brady), dorsal aspect ; $\times 30$.

Fig. 2. Ditto, ventral aspect ; $\times 30$.

- Fig. 3. *Cypris oblonga* (Brady), left valve; $\times 30$.
 Fig. 4. Ditto, abdominal ramus; $\times 120$.
 Fig. 5. *Cypris fusca*, abdominal ramus; $\times 120$.
 Fig. 6. *Cypris affinis* (Fischer), abdominal ramus; $\times 120$.
 Fig. 7. Ditto, shell-sculpture; $\times 310$.
 Fig. 8. Ditto, lucid spots; $\times 120$.
 Fig. 9. Ditto, ventral aspect; $\times 40$.
 Fig. 10. Ditto, dorsal aspect; $\times 40$.
 Fig. 11. Ditto, right valve; $\times 40$.
 Fig. 12. *Cypris striolata* (Brady), left valve; $\times 40$.
 Fig. 13. Ditto, dorsal aspect; $\times 40$.
 Fig. 14. Ditto, ventral aspect; $\times 40$.
 Fig. 15. Ditto, shell-sculpture; $\times 310$.
 Fig. 16. Ditto, lucid spots; $\times 310$.
 Fig. 17. Ditto, abdominal ramus; $\times 210$.

PLATE IV.

- Fig. 1. *Candona virescens* (Brady), right valve; $\times 40$.
 Fig. 2. Ditto, dorsal aspect; $\times 40$.
 Fig. 3. Ditto, ventral aspect; $\times 40$.
 Fig. 4. Ditto, superior antenna; $\times 100$.
 Fig. 5. Ditto, inferior antenna; $\times 100$.
 Fig. 6. *Candona albicans* (Brady), left valve; $\times 40$.
 Fig. 7. Ditto, dorsal aspect; $\times 40$.
 Fig. 8. Ditto, ventral aspect; $\times 40$.
 Fig. 9. Ditto, shell-sculpture; $\times 210$.
 Fig. 10. Ditto, lucid spots; $\times 210$.
 Fig. 11. *Cyprideis torosa* (Jones), superior antenna; $\times 100$.
 Fig. 12. Ditto, inferior antenna; $\times 100$.
 Fig. 13. Ditto, second leg; $\times 100$.
 Fig. 14. Ditto, third leg $\times 100$.
 Fig. 15. Ditto, ringed seta; $\times 400$.
 Figs. 16–18. Ditto, outlines of carapace (Gravesend specimens); $\times 20$.
 Figs. 19–21. Ditto, outlines of carapace (Warkworth specimens); $\times 20$.
 Fig. 22. Ditto, posterior margin, with spine; $\times 20$.
 Fig. 23. Ditto, ditto, with ova; $\times 40$.

IX.—On the Foraminifera of the Crag.

By Prof. T. R. JONES, F.G.S., and W. K. PARKER, Esq.

THE chief material we have had for examination in studying the Foraminifera of the Crag of Suffolk and adjacent counties is a collection liberally placed at our disposal by Mr. S. V. Wood, F.G.S., and made by him from the Crag at and near Sutton in Suffolk. This collection was referred to by Mr. Charlesworth, in May 1835, in a paper, read by him before the Geological Society of London, "On the Crag of part of Essex and Suffolk" (Proc. Geol. Soc. vol. ii. pp. 195, 196), in which he mentioned that "for his general information respecting the organic remains in the two beds" of the Crag he was indebted to Mr. Searles Wood (then of Hasketon, near Woodbridge), whose collection of Crag fossils included "fifty species of minute Cephalopods,"—Fora-

minifera being in those days regarded generally as microscopic *Nautili*, &c.

Mr. Wood's original collection has been enlarged by the accumulation of specimens since 1835; but very few additional species of Foraminifera have occurred to him in his continued examination of the Crag of Sutton and elsewhere. Many of the forms met with by Mr. Wood have also been found by us in miscellaneous hand-specimens of Crag; and we have also some additional forms from these sources. We have taken about twenty forms (mostly common) from hand-specimens of Crag in which the *Cardita senilis* abounds, and nearly as many (mostly the same) from Crag with *Cyprina Islandica*: the former (*Cardita*) is very abundant at Sudbourne, Mr. Wood informs us, and is not wanting at Ramsholt; the latter (*Cyprina*) prevails at both places in company with the *Cardita*. Some half a dozen forms we met with in a piece of Crag with *Ostrea*; but these are not uncommon forms. Specimens of Bryozoan Crag have afforded a dozen forms, mostly common in other varieties of the Crag. Specimens of Crag from Sudbourne, Aldborough, and Gedgrave have also yielded us a few Foraminifera, but, as in our other gatherings, with a paucity of individuals and poverty of size and variety that are strongly contrasted with the conditions under which Mr. Wood found his numerous and large specimens in the Crag of Sutton. On this subject Mr. Wood has remarked, in letters to us dated March 11th and August 5th, 1863:—"It is pretty nearly as you suspect: those fine specimens were from a special bed, which was at one time particularly rich in those remains; and nearly the whole of what I then considered my fifty species were obtained from the Crag at one locality in the parish of Sutton. This spot, which formerly yielded to my examination specimens by hundreds (indeed, I may say by thousands), now scarcely supplies me with any. As this locality fails to furnish me with any but the commoner kinds of shells and Foraminifera, I imagine that the rich community must have nestled in a protected nook, out of the reach of the moving waters, or in some quiet place under specially favourable conditions, and that the excavations in the deposit, as they have been extended westward, have passed beyond this particular habitat. The bed at Sutton seems to have been a bank something like the 'Turbot-bank,' about five miles south of Larne. The Crag at Sutton is somewhat isolated now, and separated from that at Ramsholt probably by denudation. At the latter place the White or Lowest ('Coralline') Crag is overlain by the Red Crag; but at Sutton it has been excavated by denudation, and the Red Crag abuts against it, as has been pointed out by Lyell (Mag. Nat. Hist. new ser. vol. iii. 1839, p. 314). Most of my speci-

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mens came from the east side of this hill, where the Crag deposit appears to have been sheltered; whilst on the west side the Crag is almost indurated, and its material comminuted." Mr. Wood adds that the true Bryozoan bank of the Crag (in which he found but few Foraminifera) is to be seen in the neighbourhood of Aldborough, Sudbourne, and Orford, overlying the bed wherein shells, with occasional Actinozoa and Bryozoa, abound.

The geological relations of the several deposits of "Crag" in Norfolk, Suffolk, and Essex have been treated of by Mr. Charlesworth in the 'Proceedings of the Geological Society,' 1835, vol. ii. p. 195, &c. ("On the Crag of part of Essex and Suffolk"); in the 'London and Edinb. Phil. Mag.' (Nos. 38 & 42, August and December 1835), ser. 3. vol. vii. pp. 81, 465, &c. ("Observations on the Crag-Formation and its Organic Remains, &c."), and in the 'Report of the British Association' for 1836, Trans. of Sections, p. 84 ("A Notice of the Remains of Vertebrated Animals found in the Tertiary Beds of Norfolk and Suffolk"); also by Sir C. Lyell, in the 'Mag. Nat. Hist.' 1839, new series, vol. iii. p. 313, &c. ("On the Relative Ages of the Tertiary Deposits, commonly called the 'Crag,' in the Counties of Norfolk and Suffolk"). Of the three recognized divisions of the "Crag," the lowest has been known as the "Coralline Crag" ever since Mr. Charlesworth so named it in 1835, on account of its abounding with little *coral-like* fossils, which, however, when duly studied, were found to be Bryozoa (Polyzoa), Corals being exceedingly rare in it. "Bryozoan Crag" ought, therefore, to take the place of this common misnomer; but "White Crag," "Lowest Crag," and "Suffolk Crag" are still better names for this division, and are already in use. For general and special information on the Crag deposits, the reader can also refer with advantage to Lyell's 'Manual of Elementary Geology,' 5th edit. 1855, chap. xiv.; and to Phillips's 'Manual of Geology,' 1855, chap. xiii. In reading the latter, however, "Bryozoan" must be substituted for "Coralline" and "Zoophytic," with reference to the particular fossils and beds referred to.

The collection of Foraminifera obtained by Mr. S. V. Wood from the Crag of Sutton comprises about forty-five reputed species, or species and important varieties recorded binomially; and here we must remark that though, zoologically speaking, many of the recognized forms of Foraminifera are not *species*, but merely varieties, of different systematic values, yet, for the sake of convenience to zoologist and geologist, they have received and retain binomial appellations, that stand in the lists like specific names. The zoological value of these names is critically indicated in our papers on the "Nomenclature of the Foraminifera,"

in the 'Annals and Magazine of Natural History' for June and November 1859; February, March, April, June, July, and November, 1860; August and September 1861; February and September 1863.

These Foraminifera from the Crag at Sutton are remarkable, for the most part, for size and abundance. The leading forms are *Miliola*, *Lagena*, *Dentalina*, *Polymorphina*, *Textularia*, *Pulvinulina*, and *Nonionina*. As a fauna, they are best represented (in our collections) by dredgings from the Atlantic, south of the Scilly Isles, at from 50 to 70 fathoms, and from the Mediterranean, on the north of Sicily, at 21 fathoms.

From all other parts of the Lowest or White Crag of Suffolk, as far as our collections serve, we have got a somewhat similar fauna, not only greatly reduced in number of individuals and variety of forms, but composed of dwarfs in contrast with those of Sutton, except in the case of some of those that inhabit shallow water, as *Rotalia Beccarii* and *Polystomella crispa*, and even these are but feeble. Hence we may suppose that the Foraminiferal deposit at Sutton was formed either in deeper or in warmer water than other portions of the Crag were. Our chief sources of these less luxuriant growths are specimens of Crag full of *Cyprina* and *Cardita*; and as the former shell lives in the British seas, at from 5 to 80 fathoms—a depth similar to that affected by the Atlantic and Mediterranean groups of Foraminifera above alluded to—we must suppose that some deteriorating influence, either cold currents, floating ice, or cold climate, was at work locally, at least, in the Crag sea, excepting possibly the Sutton area.

Similar conditions are indicated by the Bivalved Entomostraca of the Crag described in one of the Monographs published by the Palæontographical Society.

Of the Foraminifera of the Middle or Red Crag we have but a poor supply; indeed it is not easy to determine in every instance whether we have a *native* or a *derived* fossil in a specimen from the Red Crag, as this deposit has been much disturbed, and with it are mixed fossils from the Lowest or White Crag, and even from older Tertiary beds. (See Mr. S. V. Wood's memoir on this subject, 'Quart. Journ. Geol. Soc.' 1859, vol. xv. p. 32.)

The Foraminifera of the Red Crag indicate a rather shallow sea-zone; they comprise a few common species of *Miliola*, *Polymorphina*, *Textularia*, *Truncatulina*, *Rotalia*, *Calcarina*, *Polystomella*, and *Nonionina*, not abundant as individuals, nor of large size—and are such as live at present in the British seas, with the exception of *Calcarina*.

The Uppermost, Mammaliferous, or Norwich Crag (Thorpe,

Southwold, and Bramerton) yields a Rhizopodal fauna somewhat similar to that of the Red Crag.

The few kinds of Foraminifera yielded by the Chillesford Crag, a deposit regarded by Messrs. Wood and Prestwich (Quart. Journ. Geol. Soc. vol. v. p. 350) as probably contemporaneous with the Crag of Norwich (Uppermost or Mammaliferous Crag), indicate a rather shallow and cold sea (perhaps somewhat brackish too) as their probable habitat. They are *Polymorphina lactea*, *Bulimina elegans*, *Truncatulina lobatula*, *Rotalia Beccarii*, *Polystomella crispa*, and *P. striatopunctata*. Mr. Prestwich's observations (*loc. cit.* p. 351) on the probable influence of cold currents from the northern seas on the fossil fauna at Chillesford coincide with the above remarks.

Lastly, some Foraminifera collected by H. C. Sorby, Esq., F.R.S., from the Bridlington Crag*, some years ago, and kindly lent to us, have to be noticed. These comprise *Cornuspira*, *Miliola*, *Lagena*, *Dentalina*, *Cristellaria*, *Polymorphina*, *Cassidulina*, *Truncatulina*, *Polystomella*, and *Nonionina*, and are the most conspicuous of a probably more extensive fauna, nearly allied to that of the Suffolk Crag.

X.—On the Law of the Production of the Sexes in Plants, Animals, and Man. By Prof. THURY, of Geneva†.

M. THURY's memoir is divided into three parts. In the first, entitled "Deduction of the Law of the Sexes," the author indicates the course of ideas which has led him to his theory. The second, which is shorter, contains, under the title of "Résumé," the complete exposition of the author's notions. The third is a "Notice," prepared by M. Cornaz, in which this clever agriculturist describes the experiments which he has made, during two consecutive years, for the verification of the author's theory, and by which the latter has been completely confirmed.

The limits of this article do not allow of our following the author through the whole series of reasonings by which he establishes his theory. We shall only state that the study of plants, in which, by the management of the influence of external agents, the observer is enabled to instigate the development of either one or the other sex, seems to prove that the develop-

* Mr. Bean wrote of the Bridlington Crag in 1835 (Mag. Nat. Hist. vol. viii. p. 355), and Sir C. Lyell in 1839 (Mag. Nat. Hist. new series, vol. iii. p. 313. See also Phillips's 'Geol. Yorkshire,' 1829, vol. i. p. 69; and H. C. Sorby's paper on this Crag, in the 'Proceed. West Riding, Yorkshire, Geol. and Polytech. Soc.' 1857, iii. p. 555.

† Translated by W. S. Dallas, F.L.S., from the abstract by Prof. Pictet in the 'Bibliothèque Universelle,' September 20, 1863, p. 91.

ment of the male sex is always related to those general causes which induce a more complete maturation of the juices and a more perfect development of the organs.

This fundamental fact the author applies to the animal kingdom. He refers, in the first place, to the fundamental identity of the two sexes—an identity which allows us to explain the characteristic differences of the sexes by simple differences in the mode and amount of development. He then seeks the causes of these differences, by analogy with plants, in the conditions which, at a certain moment (very near the first origin of the organism, since it is anterior to the determination of the sex), produce a more complete development in the case of a male, and a less advanced or less complete development in that of a female.

It remained to fix the precise moment at which this primary determination of the sex takes place. This might be before fecundation, or during or after this act. In the former case, if the fecundation were retarded, this retardation, permitting a more complete development of the ovum, must generally induce the production of male individuals. Now, in bees, according to the observations of Huber, if the fecundation take place early, workers (*i. e.* females) are chiefly produced; whilst, if the fecundation be retarded beyond the twenty-second day, all the eggs deposited are male eggs. According to M. Thury, the decisive moment for the production of the sex will therefore precede the act of fecundation.

It is true that, in bees, the interpretation of the facts is very complex, partly on account of parthenogenesis, partly in consequence of some other peculiar circumstances in the reproduction of these insects. But the author also knew, from some previous experiments, that, in domestic poultry, the eggs last laid nearly always furnish the cocks of the clutch; and he thought it probable that the last eggs which detach themselves from the ovary of the fowl are those which have had the most time for maturation. These eggs are fecundated, as all physiologists are aware, during their passage through the upper part of the oviduct. Therefore here also, when the fecundation is retarded, males are the result.

It was easy to apply the preceding data to the uniparous Mammalia. In these the ovum separates from the ovary at the commencement of the rutting-season, and it may be fecundated at any time during the whole period that the female continues in heat, and consequently when its maturation or development is more or less advanced. If the fecundation take place at the commencement of the period of heat, a female is the result; if at the end of this period, a male. This is the conclusion which is fully justified by the experiments of M. Cornaz.

It is plain that, according to the author, the life of the unfecundated ovum is divisible into two periods. In the first of these it is in principle a female ovum, in the second a male ovum. The turning moment (*moment de vire*), according to the author, is the time (probably very short) which separates the two periods, and in which the natural course of development induces some sudden change, the nature of which histology should reveal to us. He assumes that the relative duration of the two periods of the life of the ovum may be modified under the influence of the organic state of the female, whence would result a predisposition on the part of some females to give birth either to individuals of their own sex or to males. Temperature, by its direct action upon the ovum, and the influence of the fecundating male upon the organic condition of the female, would also produce similar results.

The author, in all his deductions, appears to start from a general point of view, which he certainly indicates, but nowhere demonstrates in a positive manner, regarding it apparently as a sort of axiom. He assumes that "*sexual life, being common to animals and plants, must be subjected to identical fundamental laws in both kingdoms.*" If this be true of the two kingdoms, it must apply with still more reason to the various divisions of the same kingdom. This admits of much generalization; but (and this is the difficulty) we have yet to distinguish with certainty the facts which bear upon essential laws from the infinitely varied manifestations by which these same laws are realized in combination.

The second and third parts of M. Thury's memoir are here reproduced entire.

Second Part. *Summary and Practical Observations.*

1. Sex depends on the degree of maturation of the ovum at the moment of its fecundation.

2. The ovum which has not attained a certain degree of maturation, if it be fecundated, produces a female; when this degree of maturation is passed, the ovum, if fecundated, produces a male.

3. When, at the rutting-season, a single ovum separates from the ovary to descend slowly through the genital canal (as in uniparous animals), it is sufficient that the fecundation takes place at the commencement of the rutting-season to produce females, and at the end to produce males—the turning-point of the ovum occurring normally during its passage in the genital canal.

4. When several ova separate successively from the ovary during a single generative period (multiparous animals and oviparous animals in general), the first ova are generally the least developed, and produce females; the last are more mature, and

furnish males. But if it happens that a second generative period succeeds the first one, or if the external or organic conditions change considerably, the last ova may not attain to the superior degree of maturation, and may again furnish females.

Ceteris paribus, the application of the principle of sexuality is less easy in the case of multiparous animals.

5. In the application of the above principles to the larger Mammalia, it is necessary that the experimenter should first of all observe the course of the phenomena of heat in the very individual upon which he proposes to act, in order that he may know exactly the duration and the signs of the rutting-season, which frequently vary in different individuals.

6. It is evident that no certain result can be expected when the signs of heat are vague or equivocal. This is scarcely ever the case in animals living in a state of freedom; but cattle in the fattening-sheds or in the stable sometimes present this abnormal peculiarity. Such animals must be excluded from experimentation.

7. From the mode in which the law ruling the production of the sexes has been deduced, it results that this law must be general and apply to all organized beings,—that is to say, to plants, animals, and man.

It is necessary to distinguish carefully the law itself (1 and 2 of this summary), which is absolute, from the applications of it which may be made with more or less facility.

Third Part. Notice by M. George Cornaz.

I, the undersigned, George Cornaz, administrator of the estate of my father, the late M. A. Cornaz, President of the Agricultural Society of "La Suisse Romande," at Montet, in the Canton de Vaud, certify that I received from M. Thury, Professor in the Academy of Geneva, under date of the 18th February 1861, some confidential instructions the object of which was an experimental verification of the law which governs the production of sex in animals.

I have applied to the management of my herd of cows the data furnished to me by M. Thury, and obtained *at once, without any uncertainty, all the expected results.*

In the first place, in *twenty-two* successive cases, I wished to obtain heifers; my cows were of the Schwitz breed, and my bull a pure Durham; the heifers were in demand amongst breeders, and the bulls were only sold to the butchers. I obtained the desired result in *all* cases.

Having subsequently purchased a cow of pure Durham breed, I desired to obtain from them a new bull, which might replace the one which I had bought at great cost, without waiting for

the chance of the birth of a male. I operated in accordance with the directions of Prof. Thury, and the success again confirmed the truth of the process which had been communicated to me—a process the application of which is direct and very easy.

Besides my Durham bull, I obtained six other bulls, of a cross-breed between the Durham and Schwitz, which I intended for work: by selecting cows of the same colour and size, I obtained very well-matched pairs of bulls.

My herd consists of forty cows of all ages.

To sum up, I have made in all twenty-nine experiments according to the new process, and all have given the desired product, male or female: I have had no case of non-success. All the experiments were made by myself, without the intervention of any other person.

I can consequently declare that I regard the method of Prof. Thury as real and perfectly certain, hoping that he will soon be able to profit all breeders and agriculturists in general by a discovery which will regenerate the business of cattle-breeding.

(Signed) G. CORNAZ.

Montet, Feb. 10, 1863.

XI.—*On the Process of Mineral Deposit in the Rhizopods and Sponges, as affording a Distinctive Character.* By G. C. WALLICH, M.D., F.L.S., &c.

IN a paper published in the Number of the 'Annals' for December last, Professor Max Schultze adduces evidence in support of the opinion that the siliceous spicules found within the chambers of certain Foraminiferous shells do not constitute integral portions of these organisms, but are the products of entozootic sponge-growth,—the evidence in question being based on the strictly Foraminiferous type of the shells in which such spicules occur, on the presence of the latter being only occasional, on their position and distribution when met with, and on the characters of sponge-sarcodæ as compared with "the organic substance remaining after specimens [of *Polytrema*] preserved in spirits" have been decalcified by subjection to dilute hydrochloric acid.

But whilst this may be regarded as the circumstantial evidence in the case, the opinion advocated by Professor Schultze appears to me to be sustained by proofs of a more direct and generally applicable nature. These I shall now proceed to notice.

According to Dr. Bowerbank*, "in the early stage of their

* "On the Anatomy and Physiology of the Spongiadæ," 'Philosophical Transactions of the Royal Society' for 1858, p. 281 *et seq.*

development the spicula [of Sponges] appear to consist of a double membrane, between which the first layer of siliceous is secreted; and in this condition they present an internal cavity approaching very nearly to the size of the external diameter." And again: "the deposit of siliceous is not continuous and homogeneous, but produced in concentric layers, which, it would appear, are, at least for a period, equally secreted by the inner surface of the outer membrane and the outer surface of the inner one."

Now, although all truly *spicular* sponge-growths are formed, as here laid down, by concentric layers of siliceous secreted from two distinct surfaces, and, in their earliest condition, occasionally "approach very nearly to the size of the external diameter," unless I am much mistaken in my interpretation of the appearances, they are neither "secreted equally" from these two surfaces after the deposit of the first layer evolved by each, nor are they formed within membranous cavities.

In order to render the process intelligible, it is desirable to take as an illustration the simplest type of siliceous spicule, —namely, the common elongate cylinder, without reference to the shape of its extremities, or the closure of its tubule either at one or both ends. But first with regard to the membrane here spoken of by Dr. Bowerbank as occurring among the Spongiadæ, and asserted by Professor Schultze to be present in the Foraminifera*.

In the living or fresh sarcode, whether of the Sponges or Foraminifera, there are no membranous cavities from the surfaces of which mineral deposit takes place†. There are cavities, and these doubtless present a definite outline, but not more definite than that of the vacuole which, in the sarcode of both classes, appears and disappears without leaving the slightest trace behind. It is also true that in spirit-specimens, and under the action of acids, an amount of "hardening" is produced which causes the external layer of sarcode to assume the appearance of membrane. But, as I have endeavoured to show with regard to *Amœba* ‡, we are by no means warranted in taking it for granted that characters, manifest only under the action of a chemical reagent, have necessarily existed prior to its employment; and, in further confirmation of this view, I may state

* See paper above referred to, p. 413, where the following passage occurs: "The organic substance remaining after the treatment of specimens of *Polytrema* preserved in spirits consists of an external membrane and a tenacious brownish-red substance." † See same paper, p. 418.

‡ "On the Value of the Distinctive Characters in *Amœba*," 'Annals' for August 1863, p. 128.

that the effect of plunging albumen (the substance most closely allied in character to sarcode) momentarily into strong spirit, acid, or even hot water, is to produce on its surface a hardened membranous-looking layer, which, as seen under the microscope, has all the appearance of the ectosarc of *Amæba*. It is a remarkable fact, moreover, that in those specimens of *Amæba* in which the ectosarc presents the nearest approach in aspect to a membrane, under the application of a moderate degree of heat every trace of this vanishes, and the sarcode-mass becomes homogeneous to its extreme margin; whereas, in the encysted condition of *Amæba*, no heat, short of that capable of destroying the tissue altogether, suffices to alter the then strictly membranous character of the cyst*.

One of the most characteristic features of sarcode is its tendency to vacuolation—that is to say, the formation of cavities within its substance, occupied by fluid or solid matter†. The first step in the process of spicular deposit is the formation of such a cavity, subject, of course, to variation in shape and size in different species, but the essential character of which remains the same in every instance. Taking for illustration, then, the simplest type of spicule above referred to, a correspondingly shaped vacuole makes its appearance in the sarcode-mass, but with this singular and constant peculiarity—that its long axis is traversed by a thread of sarcode, or *vacuolar stolon*, as I propose to term it. This stolon is occasionally free at one of its extremities, but never at both. In the adjoining woodcut, a diagrammatic view is given of the order in which the successive layers of silex are deposited in a sponge-spicule, the upper end being closed, the lower open—the sectional view in each case being given immediately below. Fig. 1 represents the vacuolar cavity as seen in section longitudinally, *s* being the stolon, and *v* the space or cavity produced by endosmotic effusion of fluid containing silex in solution. There are present, therefore, two surfaces of sarcode, namely that of the cavity and that of the stolon. Each of these now secretes a layer of silex, not, however, with an intervening space between, but in the closest apposition. In fig. 2 these two layers are indicated by the horse-shoe-shaped spaces numbered 1 and 2 respectively, but which, in all probability, are formed simultaneously.

Now, as each layer becomes immediately consolidated and is

* These cysts may readily be mounted in balsam; but, in the ordinary condition of *Amæba* it is impossible to preserve a vestige of outline when so mounted.

† A vacuole may be defined as a space in a fluid of one density occupied by fluid or solid matter of another density.

non-elastic*, no further deposit can possibly be effected from either surface unless by displacement of an equivalent volume of sarcode, whether of the cavity or stolon. The next layer may therefore be formed around the stolon as in layer 4, fig. 4, or by the retrocession of the boundary of the cavity, as in layer 3,

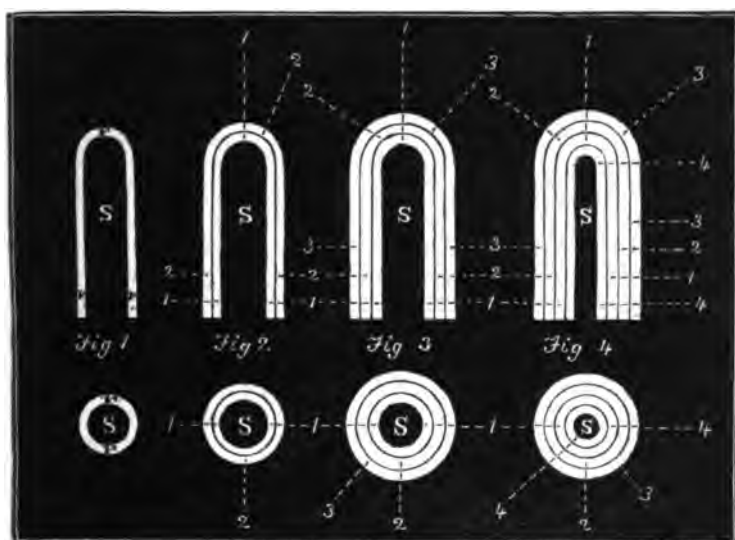


fig. 8. Most frequently the layers are deposited one within the other—this being the reason why the diameter of the first two layers (which generally represent the diameter of the spicule) is “nearly equal to the size of the external diameter,” as stated by Dr. Bowerbank. But nevertheless successive layers of silicium may continue to be added externally as well as internally. If internally, the stolon gradually diminishes in diameter, and may ultimately be altogether obliterated. Therefore, as a general rule, the greater the diameter of the tubular cavity of a sponge-spicule and the thinner its wall, the younger is the spicule, and *vice versa*†.

It has been stated that the first two layers secreted are invariably in contact. The proof of this is afforded by the fact that spicules never occur in which there are two distinct hollow cylinders enclosed one within the other, and presenting a free

* It is scarcely necessary, I presume, to state that the siliceous substance of a spicule is resilient, but not expansible.

† When the stolon is continuous with the cavity at each extremity, the layers of silicium do not constitute a sealed tube, as shown at the upper portion of the horse-shoe figures, but remain open, as seen at the lower.

intermediate space, such as would necessarily exist were the first two layers not secreted in contact. Hence it follows, that, after the deposit of the two primary layers (by the surface of the stolon and of the vacuolar cavity, as seen in fig. 2), all subsequent layers must be evolved from these surfaces in opposite directions—that is to say, centrifugally as regards the outer series, and centripetally as regards the inner one. And it may be stated that the growth of every sponge-spicule takes place in two opposite directions between its axis and periphery, and that every spicule presents an axial tube (or the remains of such tube), which was originally occupied by the *vacuolar stolon* around which its several layers were deposited.

I shall now endeavour to show that, with the exception of one group of organisms which constitute the true connecting link between the Sponges and the Rhizopods, the process of mineral deposit in the latter class of Protozoa takes place so differently from that just described as prevailing in the former, that it furnishes a most important distinctive character between the two classes.

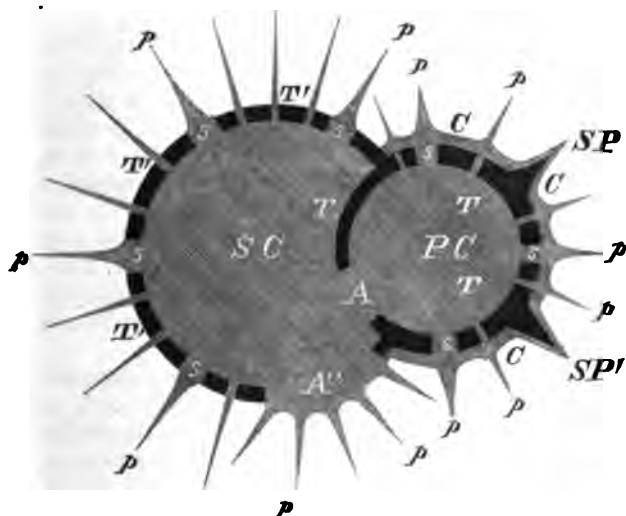
If we leave out of the question the genera *Polytrema*, *Carpenteria*, and *Dujardinia*, which are still *sub judice*, and restrict the term "spicule" to structure identical in its mode of formation with the spicules of the Sponges, no spicular growth has hitherto been met with amongst the Foraminifera. The point for decision is not whether the spicules found in these genera are true sponge-spicules (for of that fact there is no doubt), but how they came there,—my argument being that, inasmuch as they are undoubtedly true spicular growths, they cannot belong to, or be formed by, Foraminifera, and must consequently be of entozootic origin.

Figure 5 is intended to illustrate the order in which the successive layers of calcareous matter are formed in a shell of the Globigerine type, *p c* representing the primordial chamber, *τ τ* the first layer of shell secreted from the sarcode-surface with which it is in contact; *s, s, s*, pseudopodial stolons traversing the shell through the larger foramina, and terminating at times, but not necessarily always, in pseudopodia; *p, p, p*, pseudopodia taking their rise from an external layer of sarcode (or *chitosarc*, to be described immediately), and, in like manner with the pseudopodial prolongations of the stolons, not always in direct communication with the sarcode-mass within the chambers; and, lastly, *A*, the aperture of the chamber.

s c represents the second chamber; the letters *τ' τ'* the first layer of shell, as in the primordial chamber; *s, s*, the stolons, with the large foramina for their exit; *p, p, p*, pseudopodia, in this case springing directly from the sarcode-mass of the cham-

ber—A'' being the principal aperture, through which the sarcodemass is seen to bulge outwards.

Fig. 5.



The difference between these two chambers deserves special attention. As already stated, the first layer of shell is deposited from the immediate surface of the sarcodemass within, being only interrupted at the main aperture and those points through which the stolons and pseudopodia make their escape. In the normal condition of the organism, no further deposit takes place within. Every subsequent addition to the thickness of the shell-wall is made from without, and is brought about by a special layer of sarcodemass which spreads over the entire external surface from the stolons*, and thus seems to secrete the shell-substance by its gradual retrocession outwards, as in the case of the wall of the cavity in which the sponge-spicule is formed. This outer layer of sarcodemass may very readily be seen in mature *Globigerina*, and it is probably present in all Foraminifera, although visible with difficulty in some, too subtle to be appreciable in others, and perhaps taking its origin, in the imperforate genera, by a distinct reflexion of the sarcodemass through the main

* These stolons, unlike those which take part in the secretion of siliceous matter in the case of the sponge-spicule, seem designed actually to *prevent* the deposit of calcareous matter wherever they occur; since otherwise no apertures would remain for communication between the internal sarcodemass of the chambers and the medium in which the organism lives.

aperture of the last-formed chamber, after the fashion of *Gromia* *.

Of the highly important office performed by this outer layer, there appears to be no room for doubt. Owing to this importance, and the misconception that would inevitably arise were it to be regarded as made up of ectosarc alone, I have thought it necessary to distinguish it from the rest of the soft mass by the name of *chitosarc* (χιτών, a coat). But it must be expressly understood that this layer is not distinct in constitution from the rest of the sarcode, but formed out of it, and (as in the case of the naked Rhizopods) continually intermingling with the internal portion by amœbasis. It is through the agency of the internal surface of this layer or chitosarc that the increase in the thickness and strength of the shell is effected, the various complicated canal-systems formed, and all secondary deposits and the entire series of surface-markings of the Foraminifera produced†.

This layer would seem to be present in all the testaceous genera of Rhizopods. In *Gromia* it has long been recognized, and supposed to be altogether derived from a reflexion of the sarcode-mass issuing at the mouth of the test. In the Polycystina, as in the Foraminifera, it undoubtedly produces all the beautiful sculpturings for which these organisms are so celebrated. The growth of the siliceous framework of the Acanthometrina and Dictyochidæ is almost wholly dependent on its presence; whereas in the highest order of Rhizopods, namely the Proteina, it is extremely probable that it occurs also in all the testaceous genera, although, from the greater differentiation of the sarcode-substance generally, it is more delicate and less easily traceable. In this order I have not seen it; but there seems reason to suspect that in *Euglypha* and indeed all the Lagynidæ, and also in the testaceous Amœbans (as in *Diffugia* and *Arcella*), it is not only reflected from the main orifice, but escapes partly through the minute pore or pores which are distinctly visible at the apex of the test in *Euglypha*, *Codium*, *Protocystis* (Wall.), and *Diffugia*. In the latter genus the pore is at times produced into a hollow cylindrical tube of some length, as shown in my paper on *Amœba*,

* For reasons which will be given in a later portion of this paper, I am inclined to believe that the test of *Gromia* may not be strictly imperforate.

† The presence of an outer investing film of sarcode in certain Foraminifera appears to have been recognized by Dr. Carpenter and Prof. Schultze. In the 'Introduction to the Study of the Foraminifera' (p. 128), the former author accounts for the exceptional structure of *Dactylopora* by ascribing its formation to this outer film, and cites *Gromia* as an example in which it is reflected back over the entire test, from the sarcode-body protruded through the main aperture.

&c., in the Number of the 'Annals' for June last (Pl. X. fig. 18) and in those forms of *Arcella* in which a number of spine-like processes are formed, and the original chitinous test becomes covered with sandy particles, it is probably through apertures in these that the sarcode escapes.

Lastly, it is a most interesting fact, that, if we turn to the Protophytes, as, for example, the Diatoms and Desmidiæ, a layer of protoplasm, as is well known, envelopes the harder portions exteriorly. This layer is homologous with the chitosarc of the Rhizopods.

Now one of the strongest corroborations of the view here advanced is to be found in the fact that in an abnormal condition of the oldest Globigerine shells, in which the larger foramina become almost wholly obliterated by calcareous deposit (and it would appear that elective affinity exercises greater power than the inherent secretory faculty of the sarcode), a secondary free layer of shell-substance becomes deposited *within* the primary layer; and from this the delicate calcareous spines present in some of the heaviest of the free-floating *surface* Globigerinæ of tropical seas seem to be projected. At first sight these spines look like pseudopodia; they are undoubtedly calcareous, however, and, as before stated, never tubular.

In the diagram a second layer is represented as having been already added on the external surface of the primary chamber, *r c.*—this layer extending, however, only over the external area of the primordial chamber, and not over that portion of it which is covered by the second chamber, *s c.* The latter is represented as seen prior to the deposition of this outer or secondary layer—the spreading out of the stolons, so as to form the chitosarc, having yet to take place before any external addition to the shell can be brought about. Thus it has been shown that the deposit of mineral matter, of which the Foraminiferous shell is composed, takes place only in one direction at a time, and not within a cavity, but either upon or within a surface of sarcode.

The same remark applies to the spinous projections which are occasionally present. These may be traversed by a canal-system, but they never exhibit a tubule originally occupied by a stolon from which they have been partly secreted. On the contrary, they are built up of consecutive additions of calcareous matter, laid on, as it were, at right angles to their axes, and extending in one direction only, that is to say, from the axis of the chamber outwards; whilst the secreting surface constitutes a progressive mould into which the mineral matter is poured out, the base of the secreting cavity being, at the commencement of the operation, closed by the calcareous area upon which the spinous process is projected. Here it is evident that the in-

ternal sarcode of the chamber on which the spinous processes occur has no direct share in their production, from the circumstance of there being no aperture or pit at the interior point of the calcareous chamber which corresponds to the base of the process exteriorly. It may be stated, therefore, that the process of spine-formation in the Foraminifera is brought about by the secretion of calcareous matter upon an already existing calcareous surface, each successive layer being received into the mould progressively made for it by the outward extension of its investing chitosarc. Fig. 5 diagrammatically represents the process, *sp* being the first and *sp'* the second stage of spine-formation referred to.

On these grounds, then, coupled with the fact that no Foraminifera secrete siliceous matter, although several genera build up their shells by the addition of siliceous and other mineral particles derived from extraneous sources, I base my opinion that the spicules met with occasionally in *Polytrema*, *Carpenteria*, and *Dujardinia** do not constitute integral portions of these organisms, but have their origin in eutozootic growth; and further, that the process of mineral deposit in the Sponges, as compared with that prevalent in the Foraminifera, is absolutely incompatible with the formation of true spicular growth.

In the Polycystina the plan of mineral deposit is in every essential respect identical with that observable in the Foraminifera. That is to say, the siliceous portions (which do not constitute a shell, but ought to be regarded as an internal skeleton or framework) are formed by the addition of siliceous matter at right angles to the principal line of growth, and in one direction only. They are never formed around stolons, and consequently are not tubular—the finer threads of siliceous matter being projected from point to point of the reticulations, much after the same fashion that the threads of melted glass are fashioned by the glass-worker into miniature baskets, &c.,—the spinous processes so largely developed in this family forming no exception to the rule, and it being only in the earliest rudiment of the siliceous structure that the siliceous matter is deposited in the shape of an extremely minute composite but solid spicule within the sarcoblast. This identity in the plan of deposit in the Foraminifera and Polycystina, notwithstanding the difference in the mineral material and the character of the hard parts, therefore yields a reason in addition to those derivable from the organization of the soft parts for the view advanced by me regarding the ordinal unity of these two families.

* On similar grounds I consider the marginal cord in *Operculina* to be an ordinary secondary growth, in no wise analogous to spicular development.

In the Acanthometrina which belong to another order, namely, the Protodermata, the plan of siliceous deposit is nevertheless essentially the same—the elongated spines (acanthostypes) never being tubular, as erroneously asserted by Professor Müller. The appearance of tubularity in these organisms, as in the Polycystina, is an optical illusion engendered by the longitudinal ribs of which the acanthostypes may be said to be made up*.

In the Thalassicollidæ, which, together with the Dictyochidæ, are placed by me in the same order as the Acanthometrina, the plan of deposit is for the first time modified, but only to the extent of taking place in two directions from the axis of each spicule. In other words, the spicule is deposited within the sarcode entirely, but not in previously existing cavities or around stolons. Hence the silex is secreted only from within outwards.

Lastly we arrive at the Dictyochidæ, a group I have found it necessary to set apart as a distinct family, owing to the fact of their presenting the solitary example of true tubular formation amongst the whole of the Rhizopods. In the organization of their soft parts they are closely allied to the Acanthometrina and Thalassicollidæ; whilst the tubularity of their siliceous framework, and its formation of *two* separate isometrical portions, at once stamp this family as the true connecting link between the Rhizopods and Sponges. It is a singular fact that upwards of twenty varieties of these very common organisms have been described as distinct species on characters of no higher import than the number of spines or angles presented by the siliceous framework; and that some have actually been described and figured as seen in a living condition *with half of the internal skeleton deficient!*

It only remains for me to add that in other genera of the Foraminifera than those referred to by Professor Schultze (as, for instance, in *Globigerina*), and likewise in some of the Polycystina (*Haliomma*), specimens are not unfrequent in which the chambers are more or less choked up with entozootic sponge-growth; whilst the chambers of *Globigerina* are at times filled with effete frustules of a free-floating pelagic surface Diatom, namely, *Chatoceros*.

Hence, assuming the order of deposit of the mineral matter of all these structures to be constant amongst the members of the same family, the facts now advanced furnish the fullest

* In the 'Annals' for October 1863, Mr. Carter describes, under the name of *Acanthocystis turfacea*, an organism recently found by him in Devonshire, which he refers to the order Echinocystidia (Echinocystida?) of MM. Claparède and Lachmann. The spines in this form are said to be hollow; but, for reasons above given, this would at once remove it from *Acanthometra*, and indicate, in this respect, its close affinity to *Acineta*.

confirmation of the accuracy of Professor Schultze's view ; and we must henceforth regard all siliceous apicules exhibiting tubular cavities as distinct in their origin from the organisms within whose chambers they occur, unless every portion of the wall or framework of such chambers is similarly constituted.

Kensington, December 18, 1863.

XII.—On *undescribed British Hydrozoa, Actinozoa, and Polyzoa.*

By the Rev. ALFRED MERLE NORMAN, M.A.

[Plates IX., X., XI.]

ALTHOUGH the animals formerly associated in the class Zoophyta have long since been physiologically parted asunder, it is often practically convenient to unite them, or rather, perhaps I should say, to arrange them side by side, in our collecting, our cabinets, and our papers. I trust therefore that this practical convenience may be deemed a sufficient excuse for here bringing together descriptions of animals belonging to totally different classes.

I must return my sincere thanks for the assistance that I have received from my ever-kind friend, Mr. Alder. Any value that this short paper may have will be due to his accurate drawings which illustrate the species.

Class HYDROZOA.

Fam. Corynidæ.

Genus TUBICLAVA (Allman).

Tubiclava Cornucopiæ, n. sp. Pl. IX. figs. 4 & 5.

T. reticulo tubulorum conchis viventibus adherentium basali ; hydrothecis ab hoc reticulo assurgentibus cornucopiis forma similibus, supra quam infra paulo latioribus, suberectis, vix curvatis, subdiaphanis, incrementi lineis plus vel minus circumcinctis ; polypis elongato-claviformibus, tentaculis filiformibus, discretis, et in capite et in stipite sparsis ; gonophoris mori fructus formam referentibus, gonoblastidiis brevissimis, tubulis repentibus adjunctis, affixis. Pollicis quadrantem vix attingit. Mare Zetlandicum habitat.

A number of little trumpet-shaped tubes arise from a creeping base, which is attached to the shells of living Mollusca. These slightly curved tubular hydrothecæ are a fifth of an inch or a little more in height, narrowest at the bottom, and from thence of gradually increased diameter towards their distal extremity. Here and there encircling slightly elevated lines on the hydrotheca mark the successive stages of the animal's growth. The polypites are furnished with greatly elongated club-shaped heads, over the whole of which, as well as upon the upper portion of

the body, filiform tentacula are scattered. The gonophores are in the form of mulberry-like masses, at first sight apparently sessile, but really upon very short gonoblastidia, which are situated in openings in the creeping base of the hydrozoon.

Tubiclava Cornucopia was dredged in from 80 to 100 fathoms, about twenty miles north of Unst in Shetland, and was parasitic on the shells of *Astarte sulcata* and *Dentalium Entalis*. It is worthy of remark, that in every instance the hydrozoon was observed upon shells still occupied by the living Mollusca, and that it invariably had assumed a position at the posterior extremity of the shell, where it would receive the benefit of the aqueous currents caused by the mollusk, which, while providing for its own necessities, thus unwittingly performed the kindly office of feeding its hungry neighbour.

The genus in which this undescribed form is placed was established by Professor Allman in the 'Report of the British Association' for 1862.

Fam. Tubulariadae.

Genus EUDENDRIUM (Ehrenberg).

Eudendrium annulatum, n. sp. Pl. IX. figs. 1-3.

E. fruticosum; ramis majoribus crassis, coalescentium fistularum insolito reticulo obductis; ramulis numerosissimis, brevibus, passim distincte (sicut in *Coryne ramosa*) annulatis; polypis calices non expansos obsidentibus, tentaculis 16-20 præditis; gonophoris uvarum formam simulantibus, in gonoblastidiis positiss.

Hydrozoon quatuor pollices attingit. In freti "Burrafrith" cavernis apud insulas Zetlandicas vitam degit.

This *Eudendrium* grows to a height of about 4 inches, and is seen at a glance to differ from its congeners *E. rameum* and *E. ramosum* in its more shrubby and dense habit. The main stems are very thick and strengthened with a curious network of anastomosing tubes on their surface (Pl. IX. fig. 3). The smaller branches are closely and regularly ringed in every part (fig. 2), and are excessively numerous. The tubes are not expanded at their extremities to receive the polypites, as is the case in some allied species. The polypites are furnished with from sixteen to twenty tentacles. The gonophores are grouped in clusters, consisting of eight to twenty egg-shaped bodies attached round the axis of gonoblastidia, which are of moderate length.

Eudendrium is a difficult genus; but the present species appears to be very distinct from the seven British forms which have hitherto been described. It was found in a cave, known as "Buness Hall," which is one of many caverns, all remarkably rich in animal life, which penetrate the cliffs on the eastern side of Burrafrith, the northernmost of the voes of Shetland. It was

attached to the perpendicular sides of this cavern, about a foot beneath the water at the lowest spring-tide. Other, but much smaller specimens were inhabiting a rock-pool just outside the cave. These last examples, though not more than an inch or an inch and a half high, were loaded with reproductive bodies, which, however, were wholly absent from their larger brethren in the cave.

Class ACTINOZOA.

Fam. Alcyonidæ.

Genus RHIZOXENIA (Ehrenberg).

Rhizoxenia albicolor, n. sp. Pl. X. fig. 1.

R. albescens ; basi communi sive interstitiis cellularum polypiferarum convexarum latitudinis fere dimidium haud attingentibus, longitudine plerumque vix æquantibus rarissimeque superantibus cellularum diametrum.

Mare prope insulam Jersey habitat.

This species is at once distinguished from *R. catenata* (Forbes) by its colour, which is white. The polyps are placed very closely together ; their diameter is half as great again as that of the connecting creeping base, and the distance from polyp to polyp is generally less than the diameter of the polyp itself.

In these respects the present form differs widely from a white species which has previously been described by Sars under the name of *Rhizoxenia filiformis* (Sars, Faun. Litt. Norveg., sec. livr. p. 65, pl. 10. figs. 13-17).

R. albicolor was found creeping over a stone dredged off Gorey, in Jersey, in 1859.

The genus *Rhizoxenia* was established by Ehrenberg, in his 'Corallenthiere des rothen Meeres,' Berlin, 1834, p. 55, and thus has precedence of Forbes's genus *Sarcodictyon*.

Class POLYZOA.

Fam. Membraniporidæ.

Genus LEPRALIA, Johnston.

Lepralia venusta, n. sp. Pl. X. figs. 2 & 3.

L. cellulis ovatis, convexis, umbone lævi magno conspicuo in medio infra orificio sito instructis ; superficie perforata ; orificio orbiculari inferne sinuato ; peristomate simplici, inermi ; ovicecellula galeata, punctata, avicularium parvum in summo sustinente.

Cells ovate, somewhat elongated, convex, irregularly disposed, having a large and prominent smooth umbo placed a little below the mouth ; surface elsewhere perforated. Mouth nearly circular, but having a wide shallow sinus on the under lip. No spines on

the simple peristome. Ovicell in the form of a helmet, punctured in the same manner as the cells, and surmounted by a small avicularium.

Dredged on shell off Guernsey, in about 10 fathoms (1859).

This well-marked form is not likely to be confounded with any previously described *Lepralia* that we are acquainted with.

Lepralia complanata, n. sp. Pl. X. fig. 4.

L. cellulis rhomboideis, planis, immersis, perforatis, lineis elevatis inter se separatis; orificio semicirculari, margine inferiore recto evexo, superiore convexo inermi; ovicellula minima, depressa, lunata, lævi.

Cells lozenge-shaped, much flattened, having their surface punctured and separated from each other by elevated lines. Mouth semicircular, with the upper lip well arched and not furnished with any spines, and the lower lip nearly straight, but pouting. Ovicells depressed, in the form of a quarter-moon, and having their surface smooth.

This species was found among the valuable collection of British Zoophytes accumulated by my late friend Mr. Barlee, and bequeathed to me by him. It is lodged in the little hollows of a rounded and much water-worn piece of coarse-grained granite. This fact may probably hereafter lead to the identification of the exact locality of the specimen, which (there being unfortunately no label attached) is at present unknown to me. In company with it on the stone were *Membranipora spinifera*, *Lepralia spinifera* (true), and *Lepralia punctata*.

Lepralia laqueata, n. sp. Pl. X. fig. 5.

L. cellulis rhomboideis, latis, subimmersis, granulosis, puncturis marginalibus magnis lineisque elevatis sejunctis; orificio semicirculari, margine superiore dentibus tribus (?) plerumque evanescentibus armato, inferiore recto evexo denticulum penitus collocatum desuper spectato ostendente; ovicellula rotundata, convexiuscula, subimmersa, granulosa, ad marginem perforata.

Cells lozenge-shaped, nearly immersed, having their surface granular, and pierced with a single row of large punctures round the margin. The cells are separated from each other by raised lines. Mouth semicircular, apparently armed when perfect with three teeth on the upper margin, but in all the specimens I have seen only the stumps remained. The lower margin of the mouth is straight and considerably pouting. A denticle is situated within the lower lip, but is so deeply seated that it cannot be seen when the cell is viewed in front. The ovicells are round and nearly immersed, being only slightly convex.

Their surface is granular, and they are punctured round the margin in the same manner as the cells. Found on stones, from 80 to 100 fathoms, Shetland, 1861 and 1863.

This species approaches certain forms of *L. variolosa* very closely; and indeed it is difficult to point out the distinctions of the two species in words. I have seen, however, a large number of *L. laqueata*, and they all differ from *L. variolosa*,—1st, in having the cells much larger, more rhomboidal, and less elongated, wider in proportion to their length, and less regularly arranged in quincunx; 2ndly, in being invariably tinged with red in living and being ivory-white in dead specimens, and having their surface dull, instead of shining with the bright gloss which is so marked a feature in *L. variolosa*; 3rdly, in having the denticle much more deeply seated within the mouth, and in having the ovicells less immersed.

Lepralia divisa, n. sp. Pl. X. fig. 6.

L. cellulis convexiusculis, glabris, approximatis, in lineis dispositis; orificii margine superiore spinis sex longissimis armato, inferiore denticulato; ovicellula globosa, glabra, fissura angusta longitudinali parallela inferne oclusa discissa.

This is an exquisitely beautiful *Lepralia*, remarkable for its snow-white colour, the linear arrangement of its closely crowded cells, and the very great length of the six spines which surround the upper margin of the mouth. The cells themselves are small and smooth, but have little character, being quite subordinate to the mouth and ovicell, which are the parts of the polyzoary which at once strike the eye; indeed the cell is generally almost entirely hidden by the superincumbent ovicell of the cell placed immediately beneath it in its own linear series. The mouth has the lower lip furnished with two or three tooth-like points, and sometimes produced outwards into a large spatulate process or flattened umbo. The upper lip, when not surmounted by an ovicell, is furnished, as before stated, with six very long and slender spinea. The ovicell is semielliptical, much elevated, but somewhat flattened on the face, which is marked with longitudinal lines, and cleft down the centre with a narrow, parallel-sided slit, which is closed below.

Dredged in 1859, between Guernsey and Herm, on dead shells.

Lepralia divisa is allied to *L. fissa* (Busk); but the latter species may at once be known from it by the presence of a conspicuous central sinus on the lower lip, and the absence of the teeth of *L. divisa*, and by the fissure in the ovicell being triangular, rapidly widening towards and quite open at the base, and not extending so far towards the summit of the ovicell as is the case

in the narrow slit of *L. divisa*. There are other differences, but of minor importance, between the two species.

Lepralia polita. Pl. XI. fig. 1.

L. cellulis ovatis, tumidis, suberectis, irregulariter dispositis, aliquantum sejunctis; superficie lævi, nitida; orificio semicirculari labio inferiore recto, superiore quatuor vel quinque spinis evanescentibus brevibus armato; peristomate plerumque ad latus utrumque in processum parvum elevato; ovicellula globosa, tumidissima, recumbente, polita.

The living polyzoary is pinkish. The cells are oval, very tumid, irregularly disposed, and a little elevated anteriorly. Their surface is nearly smooth, and highly polished. The semicircular mouth has the lower lip straight, and the upper armed with four or five short spines, which however are very rarely present. On each side of the mouth the peristome is raised into an elevated shoulder-like process, against the base of which the ovicell, when present, rests. The ovicell is globose, tumid, and glossy, and leans backward off the mouth.

In small patches on shells and stones, dredged in 70–100 fathoms off Shetland.

Lepralia microstoma, n. sp. Pl. XI. fig. 2.

L. cellulis lageniformibus, superne liberis, elevatis, sejunctis, in strato punctato dispositis; superficie subtiliter granulosa; orificio contracto, peristomate producto, labio inferiore evexo, superiore ad apicem centralem assurgente; ovicellula globosa, tumidissima, recumbente, subtiliter granulosa.

The polyzoary in *Lepralia microstoma* frequently shows a tendency to assume an irregular outline; and processes, three or four cells wide, branch out here and there. In shape the cells are flask-like, very tumid, and gradually contracted above into a narrow neck. They are arranged without any order, and rise from a punctured crust, which fills up any interstices between the cells; their upper portion is much raised and quite free, so that the cells have a semierect position. The surface of both cells and ovicells is minutely granular. The mouth is very small, situated as it were on the top of the produced cell, and opening upwards. The peristome is much raised on the lower margin, forming a pouting lip, and on the upper rising to a central point. The ovicells are globose and very tumid, and have a backward inclination.

Encrusting small stones dredged in 80–100 fathoms in the Shetland Sea, about 20 miles north of Unst.

The general form of the cells and the manner of growth of the polyzoary of this species remind us of *L. simplex*; but the two species differ widely in all their details.

Lepralia cruenta, n. sp.

Lepralia violacea, var. *cruenta*, Busk, Cat. Marine Polyzoa, p. 69, pl. 110. fig. 1.

L. cellulis vix definitis, subovalibus, salebrosis, granulatis, paucis at magnis puncturis perforatis; orificio subcirculari, simplici, marginibus rotundate inflatis, a cellularum apice remoto; colore cruento vel nigrescente.

This is certainly not an overgrown state of *L. violacea*. The many specimens which I have seen, some of which were dredged by myself and some by Mr. Barlee in deep water at Shetland, all agree in those characters which are well represented in plate 110. fig. 1 of 'The Catalogue of British Marine Polyzoa.' If Mr. Busk had been better acquainted with the form at the time he published his work, I feel satisfied that he would not have referred it to *L. violacea*. The cells of *L. cruenta* are larger and broader than those of *L. violacea*; there is usually a slight depression in the median line of the former, but it seems to me to bear no resemblance to the central pore of the latter. The species is remarkable on account of the massive thickness of the cell-walls, their very rugged surface, and the position of the mouth, which is at some distance from the anterior extremity of the cell. The cells are ill-defined, but nearly ovate; their surface is not only undulated and (to employ a word which best expresses the appearance) puffy, but also roughly granular, and perforated here and there with large cellules. The thick cell-walls close in the nearly circular mouth with a broad, rounded fillet. The ovicells of the species are unknown to me. Deep red is the usual colour of *L. cruenta*, but one of my examples is blackish; this, however, may be the colour of the polyzoary if dead before it is dredged.

L. cruenta is generally in small roundish patches on large stones brought up from 70-100 fathoms, and is more rarely found on shell.

Genus MEMBRANIPORA (De Blainville).

Membranipora sacculata, n. sp. Pl. XI. fig. 8.

M. cellulis rhomboideis, membrana nitida, tenui, subtiliter granulosa obductis; orificio magno, cellularum dimidium fere occupante, ad latera paulum contracto, itaque tres sinus inconspicuos formante; peristomate inermi, crenato et cum margine cellularum elevato crenato continuo; ovicellulis semiellipticis, tumidis, supra lævibus, infra spatio triangulari subtiliter granuloso; aviculariis rarissimis, inter cellulas sitis, mandibulis triangularibus acutis superne directis.

The cells of this species are regularly rhomboidal or lozenge-shaped, margined with a much-elevated crenated rim, and covered in on their lower half with a thin, glistening, minutely

granular membrane. The oral aperture occupies nearly or quite half the cells, and has a somewhat three-lobed outline, from the fact that midway up each side there is a slight constriction of the orifice. The peristome is totally devoid of spines, and is an elevated crenated rim which is continuous with, and indeed represents, the cell-margin. The avicularia are very sparingly developed. When present, they are situated between the cells, are acutely triangular, and have the much-produced mandible directed upwards. The ovicells are semielliptical, tumid, and smooth, but having on the front a triangular space which is minutely granular. The colour of the species seems to be invariably pale olivaceous green.

Membranipora sacculata is not uncommon in the deep waters of the Shetland Sea, ranging from seventy to one hundred fathoms or more, and encrusting both stones and shells.

It is allied both to *M. cornigera* and *M. Rosselii*. The membrane which closes the cells is thinner than in either of those species. In the form of its cells it approaches very closely to the former, but never shows a vestige of spines, still less of the curious branched processes, and has avicularia differing totally in character from the numerous elliptical blunt-mandibled organs of that species. It may be known from *M. Rosselii* by the form of its cells, which are regularly rhomboidal and broader in proportion to their length. In *M. Rosselii* the polyzoary has the appearance of being formed of a number of loops, caused by the peculiar elongated ovate form of the cells, which are wider above than below, and by the fact that the raised marginal rim is more strongly developed round the summit of the cells than at the sides, whereas in *M. sacculata* the rim is of equal thickness throughout. In typical specimens of the former, moreover, the orifice occupies a much smaller proportion of the whole cell than is the case in the latter species.

Fam. Tubuliporidae.

Genus DIASTOPORA (Lamouroux).

Diastopora Sarniensis, n. sp. Pl. XI. figs. 4-6.

D. strato niveo, punctato, opaco, nullis lineis radiatis diaphanis notato; cellulis longiusculis, suberectis, punctatis; cellulis quibusdam capsula (forsitan ovicellula) umbone conspicuo mediano perforato instructa, superne oclusis.

Diastopora Sarniensis consists of a milk-white, opaque, punctured crust spreading upon shells, with a round or lobulated outline, and sometimes reaches three-quarters of an inch in diameter. The polyzoary is not marked with the alternate opaque and transparent radiating lines of *D. obelia*, and its

cells are more raised above the crust and tubular than those of the latter species. Here and there among the open-mouthed cell-tubes, there occurs a tube which, instead of being open, is closed above with a little cap, from one side of the centre of which rises an umbonal-like process which is perforated at the apex (Pl. XI. fig. 6). Probably these organs are connected with the reproduction of *Diastopora*, and are homologous with ovi-cells.

Dredged off Guernsey and Jersey, in 1859.

Sedgefield, Dec. 21, 1863.

DESCRIPTION OF THE PLATES.

PLATE IX.

- Fig. 1. *Eudendrium annulatum* (Norman). The hydrozoon of the natural size.
 Fig. 2. The extremity of a branch of the same species, magnified to show the structure of the branches, the polypites, and the gonoblastidia.
 Fig. 3. A portion of one of the larger stems of the same species, showing the curious network of tubes with which they are strengthened.
 Fig. 4. *Tubiclava Cornuopie* (Norman). The hydrozoon on a shell of *Astarte sulcata*: of the natural size.
 Fig. 5. A portion of the same, magnified, and showing the structure of the several parts of the species.

PLATE X.

- Fig. 1. *Rhizozenia albicolor* (Norman), enlarged.
 Fig. 2. *Lepralia venusta* (Norman).
 Fig. 3. A single cell of the same, viewed laterally.
 Fig. 4. *Lepralia complanata* (Norman).
 Fig. 5. *Lepralia laqueata* (Norman).
 Fig. 6. *Lepralia divisa* (Norman).

PLATE XI.

- Fig. 1. *Lepralia polita* (Norman).
 Fig. 2. *Lepralia microstoma* (Norman).
 Fig. 3. *Membranipora sacculata* (Norman).
 Fig. 4. *Diastopora Sarniensis* (Norman): natural size.
 Fig. 5. A portion of the same species, magnified.
 Fig. 6. A few cells and ovicells more highly magnified.

BIBLIOGRAPHICAL NOTICE.

Flora of Surrey; or, a Catalogue of the Flowering Plants and Ferns found in the County, with the Localities of the rarer Species. From the Manuscripts of the late J. D. Salmon, F.L.S., and from other Sources. By J. A. BREWER. 12mo. London: John Van Voorst, 1863.

THE preparation and publication of local Floras in England has recently undergone a change. Formerly it was thought sufficient to form a complete list of the plants observed in a county or other

limited district, and to mention the exact localities in which the rarer plants were found : anything beyond this was considered unnecessary. No attempt was then made to determine the frequency of the plants throughout the district, especially that of the more common species, nor was their history usually noticed ; but, in the place of these latter facts, we were often furnished with their generic and specific characters. It is now considered advisable to omit the descriptive part, for so many good general Floras of Britain exist that it has become unnecessary. The omission of the descriptions has allowed the space thus gained to be devoted to a more accurate account of the geographical distribution of the plants, to notices of their first observation in the district, and to other interesting subjects. This new kind of local flora was introduced by the publication of Messrs. Webb and Coleman's 'Flora of Hertfordshire;' and the same plan has been followed in the Floras of Cambridge, Essex, and that of Surrey now before us. The first peculiarity of these books is that the counties to which they relate are divided into districts, and a complete list of the plants, with their localities, is recorded for each of those divisions, by which more complete elaboration of the Flora we obtain information of much value to the botanical geographer. We learn not only that a common plant is found in the county, and perhaps abundant in one part of it, but also that it is, or is not, frequent in each of the districts adopted by the author. For instance, in Surrey, the Wych Elm (*Ulmus montana*) is frequent in two of the nine districts included in the county, it is local in one of them, apparently only planted in another, and absent from the remaining five ; also the Common Elm (*U. suberosa*) is "common throughout the county." When similar Floras of Kent, Suffolk, and Norfolk have been published, our information concerning the distribution of plants in a part of England which is very interesting to botanists (because its proximity to the Continent caused it to be the first British ground reached by what are called Germanic plants, in their migration) will be very complete, and of much use to us in forming an idea of the approximate time of arrival and rate of diffusion of them.

This book contains more than a thousand species ; and when we remember that the county is not at all mountainous nor maritime, this must be considered as a very large number, and a clear proof that the authors have spared no pains in their researches. Indeed the result is in all respects highly creditable to the late Mr. Salmon and also to Mr. Brewer, who is very far from being only the compiler, as he modestly designates himself on the title-page. He has succeeded in obtaining the help of many active observers, and is especially fortunate in receiving that of Mr. H. C. Watson, whose name appears upon nearly every page, and whose localities are recorded in a very complete and instructive manner. Of course it was to be expected that Mr. Watson would add largely to the value of any local flora to which he might condescend to contribute ; for who is not acquainted with his care and accuracy in all matters relating to local botanical geography ?

The larger portion of the volume is occupied by the list of species.

with their localities and such occasional remarks as seemed requisite; and we do not find much that requires our notice, for, of course, extracts are impossible. The author retains (as we think, unadvisedly) the name of *Spergularia*, which was given by Persoon to a section of the genus *Arenaria*, as the generic name of a genus called *Lepigonum* (1818) by Fries previously to the use of *Spergularia* as a generic name by St. Hilaire (1829) or Presl (1819). This is contrary to the laws of botanical nomenclature, according to which a term used as the name of a section has no claim of precedence over another term given to the same section when first recognized as a genus. *Impatiens fulva* seems to be extending itself along the rivers in northern Surrey, and has certainly established its claim to full naturalization in England. *Salix viridis* is a new name, if not a new species, introduced on the authority of the great Swedish salicetist, Dr. N. J. Anderson. We are unacquainted with it, unless, as suggested by Mr. Watson, it is our *S. Russelliana*. *Pinus sylvestris* is establishing itself on the heaths of the county. Is it not probable that this is only a return of one of the aborigines to its ancient habitation? There was a time when the Scotch Fir was widely extended, as a native tree, both in England and Ireland. The restoration of the name of *Hyacinthus non-scriptus* to the *Scilla nutans* of Smith (the *Endymion nutans* of some modern botanists) rather surprises us. Surely it is not really a *Hyacinthus*. *Leesia oryzoides* is stated to occur abundantly by the river Mole. We are not certain that we know what is intended by *Festuca duriuscula*. Smith seems to have given that name to a state of *F. rubra* (Linn.), whereas apparently it really belongs to a plant very closely allied to, if not a variety of, *F. ovina*.

The latter part of the book is occupied by Appendices.

Appendix A. "Plants probably introduced and not thoroughly naturalized;" fourteen in number.

B. "Plants found on the Thames side, near Wandsworth and Battersea, undoubtedly introduced to the locality." This is a long and interesting list. They were mostly observed by Mr. A. Irvine. It seems unlikely that many of them will be able permanently to establish themselves.

C. "Geological Distribution of Plants in Surrey." All the species belonging to the Flora are recited, and their geological position marked in a tabular form.

D. Here the number of species in Surrey is contrasted numerically with that of the whole kingdom, by natural orders. It appears that the plants of this county constitute three-fifths of our whole flora—Dicotyledons three-elevenths, Monocotyledons two-thirds, and Ferns and allies one-half of the total number belonging to those classes respectively.

An alphabetical Index of the orders and genera, and another of the English names, conclude the volume.

We heartily congratulate Mr. Brewer upon the production of so creditable a Flora of his county, and are sure that it will be properly appreciated by botanists out of, and especially in, Surrey.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

March 24, 1863.—W. H. Flower, Esq., F.Z.S., in the Chair.

NOTES ON TWO NEW SPECIES OF MAMMALS. BY J. K. LORD, F.Z.S., NATURALIST TO THE BRITISH NORTH-AMERICAN BOUNDARY COMMISSION.

My principal reason for bringing to your notice this evening two animals, a Musk Rat and a *Lagomys*, that I propose making new species, is to elicit from the zoologists who are before me opinions on that most debatable of all debatable questions, Where does well-marked variety end, and species begin? Is it enough if you have decided differences of habit, size, colour, and locality—variations that are always constant, but without well-defined *structural* differences, or these, if any, but trivial in character; or must there of necessity be decidedly marked variations in *structure*, particularly in the skull and dental formulæ, as well as in habit, colour, size, and habitat, to constitute a species? I now have on the table four animals, two of which are described and figured, and two I believe specifically distinct from the former; and although the latter, as I shall be able to point out to you, present differences of habit most singularly well marked, and strongly defined differences of size and colour, habitat, and range, yet an examination of their skulls shows only some slight differences, principally in size.

First, then, of the Musk Rat. The one which I believe is the well-known *Fiber zibethicus* (Cuv.) makes its holes in the clayey banks of streams and pools where the water runs slowly. The entrance is always below the surface of the water; the hole is dug up in a slanting direction till above the water-level. A stage or flat place is then cleared, which constitutes his dining-, drawing-, and bed-rooms; leading to the entrance of his mansion are a large number of open cuttings, running in all directions, cut or dug in the mud at the bottom of the water. When foraging about, as he usually does about twilight, if alarmed, he dives at once into one of these cuttings, and, rushing rapidly through it, stirs up the mud, and so fouling the water, completely and effectually conceals himself.

The other Musk Rat, which I propose to make a new species, and to call *Fiber osoyoosensis*, having obtained it at a large lake (Lake Osoyoos) situated between the Cascades and Rocky Mountains, and through which the boundary-line (the 49th parallel of latitude) runs, differs in size, in colour, in locality, but particularly in habits, from the preceding.

This fellow chooses as his haunt a clear pond or lake, and in water from 3 to 4 feet deep constructs a house of bullrushes, in form conical, built up from the bottom—how, I am at a loss to imagine,—the roof cleverly arched over into a domed shape, and raised about a foot above the water. Up in this dome, skilfully constructed, is his suite of apartments, the entrance to which is far below the sur-

face of the water. His habits very nearly approximate those of the Beaver : he swims about boldly in the day-time, but dives rapidly on the approach of danger. If a dead or badly wounded duck be left on the pool, it is at once seized on, towed into the house, and devoured.

I am quite satisfied, from careful observation, that the Musk Rat is a carnivorous beast whenever he has a chance ; and the straight, sharp-cutting, strong incisor teeth are well adapted for the indulgence of such propensities.

If there were no rushes growing where the mud-rover lived, it might be assumed that he dug a hole into the bank from lack of material to build a house ; but I have often seen the rushes growing abundantly where he has chosen his mud hut, offering every facility for architectural pursuits, had he so willed. On the other hand, had the rush-builder been precluded from finding a mud-bank in which to construct his mansion, it might have been supposed that he had resorted to making a hut with rushes on that account.

This *Lagomys*, which I propose making a new species, and calling, from its being so much less than any other, *Lagomys minimus*, lives on the summit of the Cascade Mountains, at an altitude above the sea-level of about 7000 feet. He chooses as his residence loose piles of rocks and stones. He is shy and wary, and on the slightest noise takes a header into a crevice. When everything is again still and quiet, he cautiously peeps out, and, growing bold in the silence, climbs up on the top of a stone, and, sitting on his hind legs like a begging dog, gives a sharp shrill cry ; and so curiously deceptive is it that I constantly imagined the sound was far distant when it has been close to my feet. It was in October, when I was on Ptarmigan Hill, a high mountain in the Cascade range ; the snow was just beginning to fall ; and all these little fellows were then busily employed in making large nests, in the crevices between the stones, of dry grass and leaves, evidently for their winter sleep, and perhaps store-house. I should have made much more extensive observations, had not the prospect of coming snow driven me down.

This *Lagomys*, which is much larger, and which I believe to be the same as the one described and figured by Sir J. Richardson (pl. 19) as *Lepus* (*Lagomys*) *princeps*, I first saw at Chilukweyuk Lake, a large lake on the west side of the Cascades, close to the boundary-line, and next on the trail leading from Fort Hope on the Fraser River to Fort Colville on the Columbia, both fur-stations of the Hudson's Bay Company. The animals were in a narrow gorge, among large heaps of loose stones that had rolled down from the high precipitous sides of the gorge. I saw them busily feeding on grass, much after the fashion of a rabbit, eating a few mouthfuls, then stopping and sitting up and quietly taking a survey of things in general. At this period, later in the year, about the same date at which in the year preceding I had seen *Lagomys minimus* making its nest, not a trace of a nest could I see, nor any evidence of an attempt to make one. It was at the same period of the year, and about the same altitude, that I saw this *Lagomys* at Chilukweyuk Lake ; but no nest, nor a

shadow of an attempt to construct one, was there to be seen. Early in October I returned again by the trail I had used in going from Fort Colville to Fort Hope; the snow had fallen to about the depth of 6 inches, completely covering up the rocks and stones. All the little fellows had disappeared, and, although I searched most carefully, there was not a hole nor track in the snow to show they had ever left their quarters. It was quite impossible a nest could have been made in the interim; hence I feel perfectly sure they hibernate in deep holes without a nest, whereas *Lagomys minimus*, living at a much greater altitude, makes a large nest of hay to pass his winter sleep in.

The two new animals may be described as follows:—

FIBER OSOYOOSSENSIS, Lord, sp. nov.

Sp. char.—In total length $3\frac{1}{4}$ inches shorter than *Fiber sibethicus* (Cuv.); in general size much smaller. General hue of back jet-black; but, the hair being of two kinds, if viewed from tail to head it looks grey—the under fur being fine, silky, and light grey in colour; concealing this on the upper surface are long coarse black hairs; the belly and sides somewhat lighter; head broad and depressed; neck indistinct; ear small, upper margin rounded; eye small and black; the feet, legs, and claws are so exactly like those of *Fiber sibethicus* that it would be useless to describe them again; whiskers long, and composed of about an equal number of white and black hairs; incisors nearly straight, on the external surface orange-yellow.

The skull differs from *Fiber sibethicus* in being much smaller, $2\frac{1}{4}$ inches in length, $1\frac{1}{4}$ inch in width, very much shorter from the anterior molar to incisors; nasal bones much more rounded at their posterior ends, the superior outline less curved; postorbital process not nearly so much developed; the cranial portion of the skull in its upper outline is much less concave, and smoother; superior outline of occipital bone not so prominent or strong; incisors shorter and much straighter; molars much smaller, but in general outline similar.

LAGOMYS MINIMUS, Lord, sp. nov.

Sp. char.—Differs from *Lepus (Lagomys) princeps* of Sir J. Richardson (F. B. A., i. p. 227, pl. 19) in being much smaller. Predominant colour of back dark grey, tinged faintly with umber-yellow, more vivid about the shoulders, but gradually shading off on the sides and belly to dirty white; feet white, washed over with yellowish brown; ears large, black inside, the outer rounded margin edged with white; eye very small and intensely black; whiskers long, and composed of about an equal number of white and black hairs.

Measurement: Head and body $6\frac{1}{4}$ inches; head 2 inches; nose to auditory opening $1\frac{1}{4}$ inch; height of ear from behind 1 inch.

The skull differs in being generally smaller; the cranial portion of the skull in its superior outline is much narrower and smoother. The nasal bones are shorter and broader, and rounded at their posterior articulation, instead of being deeply notched as in *L. princeps*.

Distance from anterior molar to incisors much less ; auditory bullæ much smaller. Incisors shorter and straighter, and very deeply grooved on the anterior surface. Molars smaller, but otherwise similar in form. Length of skull $1\frac{1}{4}$ inch.

General differences from *Lagomys princeps*—*First*, in being smaller, $1\frac{1}{2}$ inch shorter in total length; the ear, measured from behind, $\frac{1}{2}$ inch shorter; the colour generally darker, especially the lower third of the back.

Secondly, in the *structural* differences of the skull; for although these differences are not prominent or well defined, yet they are unquestionable variations.

Thirdly, in the habit of constructing a nest of hay for the winter sleep, and in living at a much greater altitude.

April 21, 1863.—E. W. H. Holdsworth, Esq., F.Z.S., in the Chair.

DESCRIPTIONS OF SEVERAL NEW SPECIES OF WORMS BELONGING TO THE ANNELIDA ERRANTIA AND SEDENTARIA OR TUBICOLA OF MILNE-EDWARDS. BY W. BAIRD, M.D., F.L.S.

The following very interesting species of Annelides were collected by Mr. Lord, during the time he was engaged as naturalist on the N.W. American Boundary Commission. They appear to me to be undescribed. They will be figured in the forthcoming report of the labours of the commission.

1. LEPIDONOTUS INSIGNIS, Baird.

This is a very fine species of the genus *Lepidonotus*. It is rather more than 3 inches long, and is nearly $\frac{1}{2}$ an inch in breadth, exclusive of the setæ of the feet. On the upper surface, the body is of a whitish colour, marbled with black. The sides, which are covered by the elytra, are white, and a broad black line runs down the centre of the dorsum throughout its whole length. The feet are encircled with fine black circular lines. The elytra, eighteen pairs in number, are oval, white, with black dots on the outer sides and centre, and they are marked with a black semicircular patch on the inner edge. They do not overlap each other, except near the head. On the body of the animal they are wide apart, leaving the centre of the back exposed. The under surface is of a bluish-black colour, with a narrow white line running down the centre. The proboscis is large and wrinkled, and the jaws are of a reddish-brown colour. The antennæ are five in number, the central one being nearly three times as long as the external pair, and of a pure white colour; the internal and external pairs white, ringed with black. The feet are very prominent, strong, rounded, conical, and armed with seven or eight stout brown bristles. The second branch is extremely small, and sends off two or three very small white setæ. The superior cirrus is tolerably long and sharp-pointed; it is pedunculated, the peduncle being stout, conical, and of a deep black colour. The inferior cirrus is short, conical, and sharp-pointed. The last segment of the body is terminated by two tolerably stout, but not long, cirri.

Hab. Esquimalt Harbour, Vancouver Island (*Mus. Brit.*).

2. *LEPIDONOTUS LORDI*, Baird.

This species is about 3 inches long, and rather more than one-third of an inch in diameter at the broadest part of the body. It tapers gradually from the head to the tail, which is only about $\frac{2}{14}$ ths of an inch broad. The colour is of a light brown, a broad line of a much darker brown running along the whole length of the centre of the back. On the under surface, a groove runs down the centre of the body throughout its whole length. The elytra are thirty-five pairs in number, thin, membranous, and of a light-brown colour. The first two overlap each other slightly in the middle; but, for the rest of its length, the centre of the back is uncovered. The antennæ are five in number, the central one short, of much the same length as the internal ones; the two external the longest, white, with a bright black ring round the upper part, but leaving the point white, which is acute at the apex. The feet are tolerably stout, and the two divisions are both furnished with sharp, but curved, pointed bristles. The superior cirri are white and of a moderate length; the inferior ones very short.

A good many specimens of this species were taken, and they were all found nestling under the shell, and occasionally coiling themselves under the foot, of the animal of *Fissurella cratitia*.

Hab. Esquimalt Harbour, Vancouver Island (*Mus. Brit.*).

3. *LEPIDONOTUS GRUBEI*, Baird.

This species is about 2 inches long, and $\frac{1}{2}$ an inch broad. The body underneath is of a uniform brown colour; above it is whitish, mottled with black. The elytra are eighteen pairs in number, nearly round, rough, with small tubercles, edged by a slightly raised margin, and mottled with black and white. They do not meet each other in the centre, but leave a portion of the back uncovered. The superior cirri are rather long, blunt-pointed, pedunculated, marked with a black spot at the base, where they issue from the peduncle, and are ringed with black a little distance from the extremity. The inferior cirri are short and acute-pointed. The feet are broad, and the bristles of both branches are stout, of a bright brown colour, and toothed on one edge near the extremity. The antennæ are five in number, and are all short and nearly of equal length.

Hab. Esquimalt Harbour, Vancouver Island (*Mus. Brit.*).

4. *LEPIDONOTUS FRAGILIS*, Baird.

This species, owing to its brittle character, is in too bad a state to describe accurately. It is about $2\frac{1}{2}$ or 3 inches long, and is rather narrow. The scales or elytra appear to be very thin and membranous; but as they are deciduous, it is difficult to ascertain the number, especially as the worm is broken into several pieces. The superior cirri are stout and club-shaped at the tip. There appear to be no ventral cirri on the feet, and the superior cirri become nearly obsolete on the lower half of the body.

It was found by Mr. Lord adhering to a starfish; "but," he says, "it is next to impossible to obtain one perfect, as they break them-
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selves to pieces on the slightest touch, or however carefully killed." In this respect it resembles a species of Annelide belonging to the group of vermiform Aphrodisians, described by Risso as occurring in the Mediterranean, under the name of *Eumolpe fragilis*.

Hab. Esquimalt Harbour, Vancouver Island (*Mus. Brit.*).

5. NEREIS FOLIATA, Baird.

This Nereid is of a dark grey colour above, and of a lighter hue underneath, somewhat iridescent. It is 15 inches in length, and at the broadest part is about $\frac{1}{2}$ an inch in breadth. It tapers gradually towards the tail, which terminates in two short, blunt, caudal styles. The first or occipital segment of the body is about twice the length of the second. The tentacular cirri are unequal, and vary in length: in the largest and best-developed specimen the longest are only about as long as the first two segments; while in another specimen, nearly of the same size, they are nearly equal in length to the first four segments, and in one or two small specimens, not a third the length of the two just mentioned, these cirri are equal in length to at least eleven of the first segments of the body. The shorter ones are only about half the length of the first segment of the body. The feet are well developed, the superior branchial appendages are large and in the form of a leaf, giving the animal at first sight the appearance of a species of *Phyllodon*. The antennæ are shorter than the palpi, which are strong and conical in shape.

Hab. Esquimalt Harbour, Vancouver Island (*Mus. Brit.*).

This species approaches very nearly to *Nereis virens* of Sars, from Newfoundland (*vide* Middendorf, *Sibirische Reise*, Annulos. 6, tab. i. figs. 2-6).

6. NEREIS BICANALICULATA, Baird.

This is rather a small species, about 2 inches long, and $2\frac{1}{2}$ lines in breadth. It is of a dull white colour, and is remarkable for having a channel running down both the dorsal and ventral sides. The channel on the dorsal surface is rather deep, commencing from the eleventh ring, and continues to the tail; the channel itself is quite smooth, the divisions or rings of the body not showing on its surface. On the ventral surface the channel shows marks of the divisions or rings into which the body is divided. The head is small, the antennæ about equal in length to the palpi, and the tentacular cirri are equal to about five or six rings of the body. The upper portion of the body is rounded, and not channeled; and the tail terminates in a round, blunt knob, without caudal filaments. The feet are rather small, but are rendered unusually distinct from the peculiar manner in which the rings or divisions of the body are interrupted by the channel running along the centre of the body. It tapers very gradually, and almost imperceptibly for some time, from the head to the tail.

Hab. Esquimalt Harbour, Vancouver Island (*Mus. Brit.*).

7. GLYCERA CORRUGATA, Baird.

This Annelide is about 4 inches in length, exclusive of the pro-

boscis, which, when exerted, is $\frac{3}{4}$ ths of an inch long, and is about 3 lines in breadth; the proboscis is 4 lines at its greatest diameter. The head is rather short and conical, and strongly ringed. The antennæ are somewhat broad. The feet are broad, composed of two lobes, and are destitute of branchial filaments. The bristles are jointed, and the setæ straight and sharp. The segments of the body are very numerous, composed of a double ring, the one on which the feet are set being the narrower of the two and raised; while the whole surface of the body, especially on the upper side, is densely, though not very strongly, corrugated throughout its whole length. The proboscis is densely scabrous, and covered with very short dark-coloured bristles. The body tapers to a narrow point posteriorly, and terminates in a loosely connected short lobe, armed at the extremity with a slightly curved, horny, sharp-pointed claw.

Hab. Esquimalt Harbour, Vancouver Island (*Mus. Brit.*).

8. SABELLARIA SAXICAVA, Baird.

This Worm lives in the rock. The tube in which it lodges is solitary, and is evidently hollowed out of the solid (though not very hard) rock by itself, and appears to be quite round.

The thoracic portion of the body is round; the abdominal flattened, with an impressed line running down through its whole length. The head is surmounted by an opercular disk composed of two rows of stout, dissimilar bristles (*paleæ*). The inner row consists of about ten stout, cylindrical, sharp-pointed bristles of a dark horn-colour, gradually increasing in size from the dorsal margin towards the ventral. The outer row consists of about eighteen bristles, not so stout, flattened, and finely denticulated on both sides for about half the length. The postoccipital segment of the body is long, of a dark colour, somewhat wrinkled, and marked with three or four fleshy tubercles, on each side. The thoracic feet are three pairs, and are broad, but short. As only one specimen was found, it was thought unadvisable to dissect the whole worm out; in consequence of which the extremity has not been seen. I am unable to say whether it terminates in a caudal appendage or not.

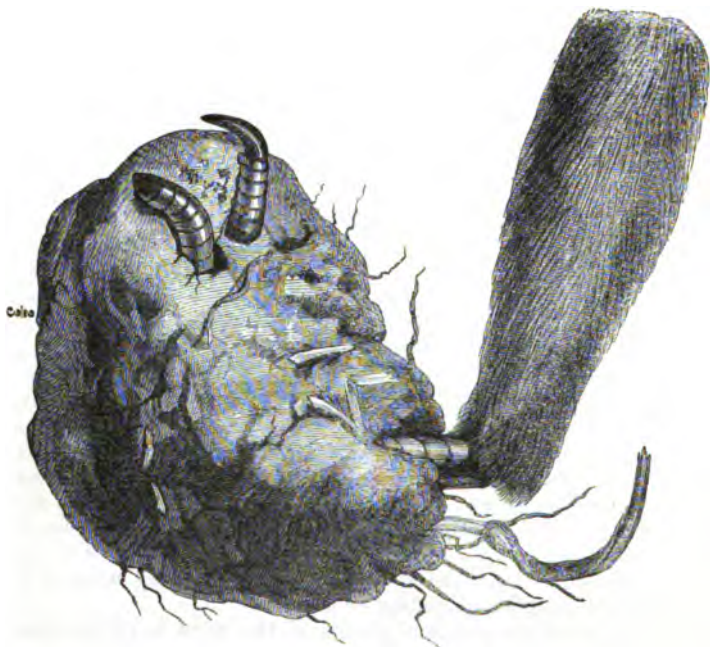
The length of the exposed portion of the worm is $1\frac{1}{4}$ inch, the breadth about 2 lines. Probably the part enclosed in the tube may be of about equal length.

Hab. Esquimalt Harbour, Vancouver Island (*Mus. Brit.*).

ON AN ILLUSTRATION OF THE MANNER IN WHICH BIRDS MAY OCCASIONALLY AID IN THE DISPERSION OF SEEDS. BY ALFRED NEWTON, M.A., F.Z.S.

Last summer, my friend Mr. Henry Stevenson, the Secretary of the Norfolk and Norwich Museum, showed me the singular specimen which, by his liberality, I now exhibit. It will be seen that it is the leg and mutilated foot of a French Partridge (*Caccabis rufa*, G. R. Gray), a great part of which is imbedded in a mass of clay. At my request he has since furnished me with the following particulars respecting it:—

"On the 8th of December 1860, Mr. Sayer, a bird-stuffer at Norwich, showed me the Partridge's leg and ball of earth which I recently placed in your hands, and, in answer to my inquiries, gave me the following particulars:—'A gentleman, whose name he did not know, but whose face was quite familiar to him as an occasional visitor to his shop, brought the leg to him a day or two before, stating that the bird to which it belonged had been seen, on a heavy-land farm in Suffolk, hobbling along in a very unusual manner, and was with little difficulty run down and secured. It was then found that the lower half of one leg was imbedded in a mass of earth, which



raised it considerably from the ground, and necessarily kept the limb in a bent position. The bird was half starved.'

"The lump, measuring $7\frac{1}{2}$ inches in circumference, and weighing $6\frac{3}{4}$ oz., had become as hard as stone, and certainly in that state accounted for the bird not having been able to free itself from the encumbrance. Two toes only are visible, of which one has the nail torn off level with the edge of the mass itself. From the upper part protrudes a short bit of straw, and this being entangled round the foot probably by degrees collected the soil, which may also have been hardened by the frost at night. The unfortunate bird may, too, have been wounded in the leg, and thus unable to endure the pain of removing the earth when it first began to accumulate. I have no reason to doubt Mr. Sayer's statement, and believe he told me what

he heard from the gentleman. The leg, when I saw it, looked fresh where it had been cut off.

(Signed) "HENRY STEVENSON."

It will be remembered that Mr. Darwin, in his work on the 'Origin of Species,' speaks of the possibility of the seeds of plants being occasionally transported to great distances by being enclosed in earth adhering to the beaks and feet of birds; and he mentions the fact of his having "removed twenty-two grains of dry argillaceous earth from one foot of a Partridge," in which earth "there was a pebble quite as large as the seed of a vetch" (pp. 362, 363). Now the mass of clay I exhibit is enormously greater than the quantity of earth mentioned by Mr. Darwin, and is sufficient to hold the germs of a very extensive flora.

Apart from the statement of Mr. Stevenson, that the lump, when he first saw it, was "as hard as stone," and the contrast thereby afforded by the "fresh look" of the leg, a close examination of the specimen convinces me that the clay, as that gentleman suggests, accumulated gradually. The two toes which are visible have become distorted, and have accommodated themselves as well as they were able to the shape of the mass. I imagine also that the loss of the claw, noticed by Mr. Stevenson, has been experienced since the mass attained nearly its present size and shape; and it will be seen that the stump has perfectly healed over. Now all this must have taken some time; I do not venture to say whether days, weeks, or months. It is clear that, as the bulk and weight of the encumbrance increased, it would more and more interfere with the bearer's means of obtaining a livelihood; and hence, weakened by starvation, the bird was finally unable to rise, and met its death in the manner stated.

If, as I believe, the clay accumulated by degrees, it is obvious that there was once a time when the incipient mass was no heavier a burthen than the bird was able to bear in flight. What the actual limit was, is a question we have no means of determining; at least I am not aware of any experiments having been made tending to show what weight a Partridge is capable of supporting on the wing. But I trust I have said enough to justify me in bringing this before the Society as a singular illustration of the manner in which birds may occasionally aid in the dispersion of seeds.

DESCRIPTIONS OF TWO NEW GENERA OF LIZARDS (HOLASPIS AND PORIOGASTER, A. SMITH, MS.). BY DR. J. E. GRAY, F.R.S., ETC.

Sir Andrew Smith, M.D., having most kindly sent to the collection of the British Museum two most interesting Lizards, which he has very properly named as the types of two new genera, I hasten to send to the Society a short description of each of them under the MS. names which Sir Andrew Smith has attached to them in his museum.

The first genus is allied to the family *Lacertinidæ*, and is at once known from all the genera of that group by the peculiarity of having

two series of broad band-like scales down the vertebral line of the back, which are continued on the upper surface of the base (and probably of the whole length) of the tail; but the single specimen which I have seen has evidently had the end of the tail reproduced and covered with abnormal scales. The tail is depressed, and has a series of prominent keeled scales, forming a dentated keel on each side.

This genus I consider forms a distinct family, which may be called *HOLASPIDÆ*, distinguished from *Lacertinidæ* by the form of the tail and the peculiarities of the scales.

1. *HOLASPID*, A. Smith, MS.

Head pyramidal, depressed; crown covered with regular, many-sided shields; side of face shielded; nostrils nearly on the ridges near the front of a single scale with a shield in front of it; labial shields low; temple covered with small scales; eyes lateral; lower eyelids scaly; eyebrow covered with three large shields; ears large, oblong, erect, open; tympanum rather sunk; tongue slender, retractile (?); the apex deeply notched, acute. Body depressed, with a slight keel on each side of the belly. The back and upper part of the neck covered with whorls of narrow elongated keeled scales, with two series of smooth, oblong, transverse shields, one on each side of the vertebral bones. The belly covered with cross series of square smooth shields, placed in few longitudinal series. The throat and neck covered with small rather convex scales, and with a distinct collar formed of a regular series of large half-ovate scales. The legs rather depressed, covered with granular convex scales; the front legs with a series of broad smooth shields on the upper front side; the thighs with two (an upper and lower) series, and the hind legs with an inferior series, of smooth broad shields, like those on the front of the fore legs; the hind feet slightly fringed on the inner side; toes 5 : 5, elongate, slender, unequal; claws acute. The femoral pores small. Vent with a single half-oblong shield in front. Tail depressed, with a fringe of compressed close scales on each side, the sides covered with rings of small convex scales, and with two series of small broad band-like shields on the upper and lower surface.

Mr. Cope has pointed out to me that this genus agrees in many particulars with the genus *Placosoma* of Fitzinger, MS., described by Von Tschudi in an article on the family of *Ecleopoda* (Arch. für Naturg. 1847, pp. 50 & 58).

The scaling seems very similar; but the body of *Placosoma* is not said to be so depressed and fringed on the sides; and the small part of the tail that remains on the specimen described is not said to be depressed and fringed on the sides; and I can hardly believe that Von Tschudi would have overlooked such a peculiar form, and therefore I believe they are different.

Von Tschudi describes the scales on the upper surface of the small part of the tail that remains, which is only 3 lines long, as small, like those on the sides; but in Dr. Smith's genus the upper surface of the tail is covered with two rows of large shields, like the back.

Placosoma cordylinum is described from a specimen in the Museum at Bonn, on the Rhine, collected by Dr. John Natterer in North Brazil; and it is probable that the *Holaspis Guentheri* may also be a Tropical-American form.

HOLASPIIS GUENTHERI, A. Smith, MS.

Bluish brown (in spirits), with three bluish-white equidistant regular lines down each side of the head, neck, and body, and a stripe down the front of the fore leg.

Hab. — ?

The specimen was purchased in Paris without any habitat affixed to it.

The tail has been reproduced, and the reproduced part is of the normal form, fringed and toothed on the sides, but of a different (that is to say, uniform dull leaden) colour.

The second genus has many characters in common with *Xantusia* of Baird, and will most probably belong to the family *Xantusiidae*, as proposed in the 'Proceedings of the Academy of Sciences,' Philadelphia, for 1858, p. 255.

2. PORIDOGASTER, A. Smith, MS.

Head pyramidal; sides erect; crown flat, hard, bony, covered with very thin polygonal normal shields; superciliary ridge bony, solid; temple covered with a shield; lower jaw thick, bony, solid, covered with a single series of large broad, thin, membranous shields, which are united in a straight line on the middle of the chin; eyes circular, large, lateral, without any eyelids; pupil large, circular; tongue not retractile, broad, flat, attached nearly to the tip, the tip only obscurely nicked; teeth simple; ears oblong, large, with a groove to the angle of the mouth; tympanum sunken; nostrils lateral, anterior in the suture between two nasal shields, the front situated between the upper edge of the rostral and the front odd plate. The sides of the neck and throat covered with round, convex scales of moderate and nearly uniform size. The throat with two folds on each side, and with a cross fold in front of the chest; these folds are covered with scales of the same size and kind as the rest of the throat. The back of the neck, back, and sides of the body covered with uniform, convex, roundish scales, with numerous scattered, larger, prominent, conical, tubercular scales placed in longitudinal rows along the centre of the back, and larger and more abundant ones on the sides. The belly covered with cross series of square flat smooth shields, most of which have a dark large pore-like crypt in the middle of their hinder edge; the shields of the chest are smaller, more numerous, and placed in converging lines. The legs strong, covered with round convex scales; the hinder ones armed with larger prominent tubercles on the upper surface. Toes 5 : 5, unequal, slender; claws sharp, curved, the under surface covered with flat shields; femoral pores large, distinct. The front of the vent covered with three pairs of equal flat shields, each having a very large crypt in the middle of its hinder edge, the hinder pair next the vent being the largest. The tail cylindrical, tapering, covered above with rings

of square keeled scales, every fourth ring being larger, prominent ; the under side with rings of small square shields.

PORIODOGASTER GRAYII, A. Smith, MS.

Brown, yellowish beneath.

Hab. — ? British Museum.

Mr. Cope, to whom I have shown the specimen of this species, has drawn my attention to the genus *Xantusia* of Professor Baird, noticed in the 'Proceedings of the Academy of Natural Sciences' for 1858, p. 255, which agrees with it in many particulars, but is certainly distinct, though probably belonging to the same family, *Xantusiidae*, which may be characterized by the form of the tongue, the front fold on the throat uniting the ears, and the absence of the eyelids.

Professor Baird describes the pupil of *Xantusia* as vertical ; in our genus it is circular.

This similarity to *Xantusia* makes it probable that this genus is from Lower California.

M. Auguste Duméril, in the 'Revue et Magasin de Zoologie' for 1852, describes and figures a new genus of Saurian under the name of *Lepidophyma flavimaculata* (t. 17), from the province of Peten in Central America, which resembles this Lizard in many particulars ; but he particularly says that it has no femoral pores, which he says are found in all the *Zonures* with which he has compared it.

M. Duméril's genus is probably the same as the *Xantusia* of Baird ; but cannot be the same as the one here described, which is peculiar, not only from having large femoral pores, but pores on the ventral shield as well.

May 12, 1863.—E. W. H. Holdsworth, Esq., F.Z.S., in the Chair.

ON A NEW SPECIES OF CALLISTE FROM COSTA RICA.

BY OSBERT SALVIN, M.A., F.Z.S.

CALLISTE DOWII, sp. nov.

Supra nigra : dorso vix viridi lavato, plumis nuchæ et laterum colli utrinque argentescenti-viridi terminatis, pilei margine postico ochraceo marginato : uropygio argentescenti-viridi, tectricibus superioribus reetricum cyaneis : subtus gula tota nigra : pectore superiore nigro, plumis viridescenti-cinnamomeo terminatis : ventre imo cum crisso et lateribus cinnamomeis, pectore inferiore paulo dilutius : primariis usque ad terminos, secundariis, tectricibus alarum et reetricibus omnino nigris, pogoniis externis omnium cyaneo marginatis, tectricibus subalaribus albis, vix cinnamomeis ; campterio cyaneo, albo vittato : rostro nigro, mandibulæ inferioris basi albida : pedibus flavo-nigris.

Long. tot. 5·25, alæ 2·9, caudæ 2, tarsi 1·75, poll. angl.

Hab. Costa Rica.

This is a very distinct species, and unlike any of the genus. The greenish-silvery feathers of the neck and the green uropygium suggest the group which Dr. Sclater unites under the head of *Procnopis*, as its proper position in the genus, its nearest ally being the New Granadian *C. nigriviridis*, from which, however, it differs essentially.

This makes six species of *Calliste* now known to inhabit Central America and the Isthmus of Panama, viz. *C. larvata* from the hot forest-region of the Atlantic side of Guatemala, *C. Francescæ** from Costa Rica and Veragua, *C. Dowii* from Costa Rica, *C. Frantzii* from the same country, *C. gyroloides*, a species ranging from Costa Rica to Bolivia, and *C. inornata* from Panama to the Isthmus of Darien.

The single specimen of this *Calliste* now described was procured by Capt. J. M. Dow, Corr. Mem. Z.S., at San José, the capital of Costa Rica, during a short visit he paid to that city in the early part of the present year, and by him most kindly presented to me. He was unable to inform me exactly whence it came; but it was most probably obtained from the low forest-region of the Atlantic slope.

I dedicate the species to Capt. Dow, whose researches in the marine fauna of Central America are too well known for me to need to dilate upon the justice of the appellation.

OBSERVATIONS ON THE BOX TORTOISES, WITH THE DESCRIPTIONS OF THREE NEW ASIATIC SPECIES. BY DR. J. E. GRAY, F.R.S., ETC.

The knowledge of the animals of our own country is progressive and only gradually acquired; and how much more so must it be as regards the species which we receive from a distant country, whence we get only isolated specimens, and often in a more or less imperfect condition, without any account of how they live, and what they eat, and in what manner they conduct themselves!

In such cases how can we do more than guess at what is a species, and into what groups the species should be divided? and yet, because we doubt in what we are doing (and the older we become in the study, the more do we see the necessity for doubting, and the more do we see the imperfection of our materials)—yet, on the doubts which arise from such causes and not from any want of faith in the principle that species are permanent, if we only had materials enough to study them properly, do theorists wish to support the theory that species gradually pass into each other, and have been derived, or rather have originated, from such transformations. Never was a theory more baseless, as far as our knowledge is concerned.

This imperfection of our knowledge is specially the case with respect to exotic Tortoises, of which we sometimes only procure the shell, at other times the animal with the shell in a more or less perfect condition; and when the latter is procured, we find that the conclusions that we had come to as regards the probable form of the animal, or some part of it, are more or less incorrect, and we are thus obliged to reconsider the situation the species occupies in the series.

* I had considerable doubts whether this species was really separable from *C. larvata*, but, having examined a number of skins of both species, have come to the conclusion that the distinction, small as it is, is constant. Dr. Schöter has pointed out in his 'Monograph' what the differences are, to which I may add that *C. Francescæ* seems a lighter rather than a brighter bird than *C. larvata*; the blue on the forehead is a trifle broader in the former; and the outer bluish-green margin to the middle wing-coverts of the latter is almost obsolete in the former. In fact, there is just a difference, and that is all.

Having lately received more perfect specimens of some of the Indian Box Tortoises, I am induced to suggest their arrangement as follows :—

The Tortoises belonging to the tribe *Cistudina* are characterized by having the sternum attached to the back by a ligamentous suture on each side, and divided across the centre by a similar cross suture, leaving the front and hind lobe more or less moveable.

In the *normal Cistudinae*, which have the lobes of the sternum moveable at all ages, the cartilaginous sutures and the suture between the pectoral and ventral shields of the sternum are at the same situation; and the lobes of the sternum are broad, as broad as the opening of the thorax, and cover the legs when they are contracted.

The *normal Cistudinae* may be divided into genera, according to the more or less aquatic habits of the animal, as indicated by the structure of the feet.

- I. *Sternum-lobes unequal; front shorter, almost free from the symphysis. The hind foot slender, elongate; toes very unequal, second longest.* N. America.

1. CISTUDO.

Thorax convex, solid; sternum rounded or truncated before and behind; the front lobe smaller, almost free from the symphysis. The fore legs with large shields in front; the toes short, enclosed, not webbed, with short conical claws. The hind feet elongate, narrow, with the second toes produced; the rest short, nearly enclosed, not webbed; the soles of the feet with subequal moderate-sized scales, the hinder edge rounded.

N. America.

- * *The hind feet with small hinder or outer fourth toes.* Cistudo.

CISTUDO CAROLINA, Gray, Cat. Shield Rept. B.M. p. 39.

Of which *C. ornata* and *C. major*, Agassiz, seem to be varieties.

- ** *The hind feet without any small fourth toes.* Onychotria.

CISTUDO MEXICANA, Gray, Cat. l. c. p. 40.

See also *C. triunguis*, Agassiz, which is said to be smaller than *C. carolina* and *C. mexicana*.

Dr. Holbrook describes and figures *Cistudo Blandingii* (t. 3) as a separate species, because it has a head like *Emys*, the upper jaw deeply emarginate in front, the front lobe of the sternum less elevated. On these characters Leconte refers it to *Lutremys*, and Agassiz to *Emys*, as restricted by Bonaparte, who regards *E. europæa* as the type. The figures of Holbrook look very like *Cistudo carolina*; but Agassiz, who forms for it a subfamily, describes it as much more depressed. It is probably distinct; but I have never seen an American Box Tortoise that could be arranged or confounded, as Leconte has done this, with our European *Lutremys*. It certainly is not *E. Meleagris* of Shaw, as Agassiz believes.

II. *Sternum-lobes subequal, both forming part of the lateral symphysis.* The Old World.

i. *Hind foot elongate; toes very unequal, nearly free, second longest.*

2. PYXIDEA.

The thorax convex, solid. Sternum flat; lobes rather narrow, truncated in front, notched behind. Legs with large band-like thin shields in front; toes short, scarcely exerted, with band-like shields above, slightly webbed. The hind feet rather elongate: toes slightly webbed, short; the second rather elongate, produced, with a large claw. Claws conical, acute.

PYXIDEA MOUHOTII.

Cyclemys Mouhotii, Gray, Ann. & Mag. N. H. 1862, x. p. 157.

Hab. Lao Mountains, Siam.

The back is flattish and sharply three-keeled.

ii. *The hind foot elephantine; toes subequal.*

3. CISTOCLEMMYS.

Thorax convex, solid. Sternum nearly flat, rounded before and behind; the front lobe large, partly enclosed in the symphysis. The fore feet subclavate; the toes very short, nearly enclosed, not webbed; the claws short, blunt. The hind feet elephantine, subcircular; toes very short, enclosed. Soles with two series of large prominent shields; the hinder edge keeled, but scarcely produced. Tail shielded beneath. Asiatic.

This genus, in the convex and solid structure of the thorax, is like *Cistudo*; but the foot is more like that of the Land-Tortoises; and the hind foot is subcylindrical, instead of elongate as in the American genus.

CISTOCLEMMYS FLAVOMARGINATA.

Dark brown, shields of the back deeply concentrically grooved; the sternum flat, black; the lower side of the margin of the thorax yellow; head olive, temple yellow, with a yellow streak on each side of the crown, becoming wider and triangular behind.

Cuora trifasciata, var., Gray, Cat. Shield Reptiles in B.M. p. 42. Specimen c.

Hab. China (*J. Reeve, Esq.*); Formosa (*R. Swinhoe, Esq.*).

The surface of the shell is often more or less eroded; the one which we first received from Mr. Reeve was so on the whole upper surface. The form of the foot, as well as the height and thickness of the shell, at once separates this species from *Cuora trifasciata*, with which I formerly confounded it.

Mr. Swinhoe informs me that this Tortoise is very abundant in the ponds in the district of Tamsuy, N.W. Formosa. He did not fall in with it in South Formosa, where the *Emys Bennettii** is the prevailing species. He has frequently seen the Tamsuy Tortoise showing its head and the top of its back on the surface of the water

* *Emys sinensis* proves to have been founded on the young state of this species, as is shown by the fine series of specimens brought from Formosa by Mr. Swinhoe.

in ponds about the rice-fields, and has watched them basking, several at a time, on the tops of large stones in such ponds.

- iii. *The hind feet flattened, fringed; toes webbed and with band-like shields above.*

4. CUORA.

The thorax rather convex, more or less three-ridged. The sternum flat; lobes subequal, both enclosed in the symphysis. Head flat at top; eyes lateral. The front of the fore legs with large scales. The toes all banded above, webbed. The claws conical. The hind feet depressed; the hinder edge fringed and angularly produced. Asiatic.

- * *The head large, flat, with two yellow streaks on each side; back one-coloured; toes broadly webbed.* Cuora.

CUORA AMBOINENSIS, Gray, Cat. Shield Reptiles B.M. p. 41.

Hab. Amboina; Gilolo (Wallace); Borneo (Wallace).

- ** *Head smaller, oblong, with two dark streaks on each side; back three-banded; toes narrowly webbed.* Pyxiclemmys.

CUORA TRIFASCIATA, Gray, Cat. Shield Rept. B.M. p. 42.

Hab. China.

5. LUTREMYS.

Thorax depressed. Sternum flat; lobes subequal, both enclosed in the symphysis. Head ovate; eyes superior. The legs with large scales in front. The feet depressed; toes webbed, banded above; the hind feet fringed and angularly produced behind. Claws elongate, acute.

LUTREMYS EUROPÆA, Gray, Cat. Shield Reptiles B.M. p. 40.

Hab. Europe.

Very variable in colour.

- iv. *Toes webbed; they and legs covered with very small scales; front legs only with thin band-like plates in front; the lobes of the sternum narrow.*

6. NOTOCHELYS.

Back convex, flattened above. The sternum flexuous; lobes rather narrow, truncated in front and behind. The legs and toes covered with minute scales; the front legs having a series of broad, thin, band-like shields in front. Toes webbed. Claws acute.

This genus is like a true *Emys* in most of its characters; but the sternum is scarcely raised above the underside of the margin, and is united to the thorax by a cartilaginous symphysis; the lobes are separated by a straight depressed suture, but scarcely moveable. It differs from all the other *Cistudinæ* in the legs and toes being covered with minute lanceolate scales as in *Batagur*, with only a few very narrow shields near the claws.

NOTOCHELYS PLATYNOTA.

Emys platynota, Gray, P. Z. S. 1834, p. 54.

Cyclemys platynota, Gray, Cat. Shield Reptiles B.M. p. 43.

Hab. Sumatra; Singapore (*Wallace*).

The head with a pale streak on each side, extended down the upper part of the sides of the neck.

The young specimens have one small black spot on the back edge of the areola of the costal, and two on the back edge of the areola of the vertebral plates.

In the *aberrant Cistudinæ* the lobes are only moveable in the young state; the suture that divides the bones of the sternum into two parts is straight and transverse, while the front edge of the pair of ventral shields overlaps its edge and forms a sinuous line in front of the suture. The lobes of the sternum are narrower than the opening of the thorax, as in *Emys*, and do not cover the legs when they are contracted.

This genus forms the transition to the Tortoises with solid and fixed sternum; but it is easily known from them by the sternum being scarcely raised above the margin of the thorax, and by the existence of the cartilaginous sutures between the sternum and thorax.

7. CYCLEMYS.

The thorax convex or depressed. The sternum flat or slightly convex, with the lateral symphysis well marked, truncated before and notched behind; the cross suture indistinctly marked and narrow, more or less obliterated in the adult, covered with the produced front edge of the ventral shields. The legs covered with large, band-like, thin plates in front. The toes banded above; the front one short, webbed. The hind feet flattened, with the toes broadly webbed; the hinder edge keeled and angularly produced.

* *Thorax depressed, suborbicular.*

1. CYCLEMYS ORBICULATA, Bell, P. Z. S. 1834, p. 17.

Cyclemys dentata (adult), Gray, Cat. Shield Reptiles B.M. p. 42, t. 19.

Shields brown-rayed.

Hab. Java.

The small figure of *Emys dentata* of my 'Illustrations of Indian Zoology' represents, I think, probably the young of *Geoemyda grandis*, Gray (Ann. & Mag. N. H. 1860), judging by the series of specimens brought by M. Mouhot from Camboja. The larger figures are those of a young *Batagur*.

** *Thorax oblong, convex.*

2. CYCLEMYS OLDHAMII.

Thorax oblong, convex; back flattened, bluntly keeled, and with a convexity in front, and two acute prominences at the end of the two last vertebral shields; costal plates rather convex, with the areola on the upper hinder margin; shields concentrically striated, brown, with some black lines on the part of the costal shield near the lateral keels; margin toothed behind. Thorax flat; shields pale, with dark rays.

Cistudo dentata (adult), Gray, P. Z. S. 1856, p. 183; Bell, Testudinata, t. (with animal)?

Hab. Mergui (*Professor Oldham*); Siam (*M. Mouhot*).

I was formerly inclined to believe this was an adult of the former species; but we have lately received a second specimen, which proves that it is perfectly distinct.

3. CYCLEMYS OVATA.

Thorax ovate, grey-brown, convex, hinder edge acutely dentated; the middle of the back rather flattened, bluntly keeled in front and above, and acutely keeled on the shelving hinder parts; the side shelving, the front slightly and the hinder part rather deeply impressed; the upper part of the costal plates convex; the sternum pale grey-brown.

Hab. Sarawak (*Wallace*, no. 138).

The specimen is not in a good state; probably the animal had been in confinement and was out of health; the cross suture on the sternum is much eroded on the edge, and the shell seems to be discoloured.

There is a second specimen, which was presented to the British Museum by Sir Andrew Smith, C.B., without any habitat, which is perhaps a younger stage of the species; but it does not show any mark of the transverse suture on the sternum, and the marginal plates are all broad and equally so, while, in the specimen from Borneo, the fourth, fifth, and sixth lateral marginal plates are much broader than the others on each side, and ascend up into the margin of the costal ones; and the sides of the shell are rather more convex in front, and only slightly and not so deeply impressed behind.

The shell is uniform pale brown above, and brown below, with regular close radiating paler rays, which are wider and more distinct



near the margin of the shield. The areola on the vertebral shield is close to the hinder margin, near the upper hinder angle of the costal shields, and it is near but not on the hinder outer edge of the sternal shields.

The dried animal is brown; the front edge of the fore legs is covered with irregular-sized scales.

Mr. Bell, in his 'Testudinata,' gives two figures of the underside of the shell of his *Cyclemys orbiculata*; and in his text says that he

cannot assent to M. Bibron's referring this species to the genus *Cistudo*. These undersides evidently represent two distinct species; and the upper figure of the two shows the very cross suture the existence of which Mr. Bell denies.

The lower figures represent the sternum of *Cyclemys orbiculata*, with the lobes, especially the hinder ones, narrower than the openings in the thorax.

The upper figure represents a species where the lobes are broad and rounded, and nearly as broad as the aperture in the thorax.

It indicates the existence of a species which has not occurred to me, and to which the name of *C. Bellii* may be applied. Perhaps it is one of the specimens which he received from either Madras or Bombay; for he says he has received them from those countries as well as from China; and I have not seen any specimens of the genus from either of these two localities.

All the three specimens of this species in the British Museum have the lobes of the sternum narrow, like the lower figure. The figure of the shell with the animal in Mr. Bell's work better represents *Cyclemys Oldhamii* than the depressed, flattened *C. orbiculata* of Java.

MISCELLANEOUS.

Notes on Pustularia rosea, Gray, and Hyalonema.

By Dr. J. E. GRAY, F.R.S. &c.

IN Mr. Dallas's translation of Prof. Schultze's paper on *Polytrema miniaceum* (Annals, ser. 3. vol. xii. p. 411), it is stated that I have given to *Polytrema miniaceum* the new name of *Pustularia rosea*. This is a mistake: *Pustularia* is quite distinct from *Polytrema*. The latter genus is well known to me. *Pustularia*, if a Foraminifer, is nearly allied in external form to the genus *Lepralia*, and very unlike the massive *Polytrema*.

Having my pen in my hand, I may observe that I cannot agree with Prof. M. Schultze in regarding the spicula in *Carpenteria* or *Polytrema* as parasitic and part of a Sponge, any more than I can agree with him and Dr. Bowerbank in regarding the fibres of *Hyalonema* as the spicula of a Sponge which is covered with a parasitic *Zoanthus*.

Note on Ophiolepis gracilis (Allman), from the Brick-Clay of Seafeld. By ROBERT WALKER.

Specimens of this Starfish were found for the first time, about a year ago, in brick-clay near Dunbar. Prof. Allman described the species at a meeting of the Royal Society of Edinburgh, in March last. The following remarks will show the condition of the Seafeld specimens, and may assist in determining the species, if found in other quarters.

None of the specimens have the disks sufficiently preserved to show clearly the arrangement of the dorsal plates; and in one or two instances only can the form of the radial shields be made out. Their

inner margins are straight; the outer nearly parallel, and somewhat rounded toward both ends. Prof. Allman says that in his specimens these shields "have their opposed edges in contact for their entire length." In almost every case the animal has split up horizontally, and the shields of whichever side happened to be uppermost have been lost, apparently, with the upper layer of clay. Of course, it is the internal surfaces of the shields only that are presented to view; and in no instance can the dorsal shields of the arms be seen in position. In one or two individuals, however, that lay on the dorsal surface, the inner sides of these shields are exposed; their margins are parallel across the arms, and they meet each other by slightly bevelled edges. At the proximal end these dorsal shields are broader than long; but this is gradually reversed as they approach the extremity of the arms, where the length is nearly double the breadth. In some of the arms the central ossicles which form their axis are preserved, about half the length of the former. When these ossicles are lost or removed, the inner sides of the lateral shields can be distinctly seen; each shield meets that of the opposite side by a median suture on the lower side of the arms; in some cases this suture can be traced to almost the extreme points of the arms; but when the shields are in their natural position, it is not so apparent. Each lateral shield has a small knob on the internal surface, in most cases placed near the aboral margin. The notches on the aboral edges of the lateral shields, for the exit of the cirri, mentioned by Allman, can be readily seen. The spines on the lateral shields are difficult to distinguish, and can be seen in one or two instances only; they appear to be rather short, and there are indications of two on some of the shields; the condition of the present specimens, however, will scarcely admit of a positive statement on the point. The ventral shields are very small, and can be seen, in a few instances, in the inside view of the arms, more especially where the lateral shields are a little apart at their lower angles.

The specimens are of various sizes. In the largest specimen the disk is $\frac{2}{3}$ of an inch in diameter, and each arm is about 2 inches long. The arms are preserved to the minute points; from which we may infer that the animals had been suddenly killed, otherwise we should have expected to find them in a disjointed state.

The Seafeld Brick-Clay is about two miles west from St. Andrews. The bed containing the fossils is from 15 to 18 feet above the level of the sea. The present condition of the clay-pit will not admit of the section being correctly taken; it may, however, be stated roughly to consist of—(1) red sandy clay, containing a few small stones; (2) finer red clay, containing some nodule-looking concretions; (3) tenacious clay, of a bluish colour, without any stones. This latter bed is about 15 feet from the surface; and from it the fossils were obtained.

Since the above was written, Mr. Meldrum (through whose efforts the Starfishes were preserved) has informed me that fragments of shells are sometimes found in the upper beds; they will be taken care of in future, and may form the subject of another Note.

THE ANNALS

AND

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[THIRD SERIES.]

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XIII.—*List of the British Pycnogonoidea, with Descriptions of several new Species.* By GEORGE HODGE*.

[Plates XII. & XIII.]

No complete list of the British Pycnogons has appeared, and such information as we possess is scanty and scattered. It is difficult to account for this neglect, as these animals possess considerable interest, both in their life-history and their peculiarly degraded physiological features.

An examination of such records as I have been able to consult has enabled me to compile a list of twenty-two species—the total number recorded as British. With two exceptions (that of a *Phoxichilidium* by Mr. Gosse, and a *Phoxichilidium* and a *Nymphon* by myself), no new species have been published since Harry Goodsir's and Dr. Johnston's time: the former described seven species, principally from the Frith of Forth; it is possible, however, that two or three of them might not sustain a very critical examination. The list, as it now stands, contains

13	species of	<i>Nymphon</i> ,
2	„	<i>Pallene</i> ,
4	„	<i>Phoxichilidium</i> ,
1	„	<i>Pasithoë</i> ,
1	„	<i>Phoxichilus</i> ,
1	„	<i>Pycnogonum</i> ,

making in all 22 species, including the 4 which were recorded in my Report of the Pycnogons obtained last year, during the

* Communicated by the author, having been read at the British Association Meeting at Newcastle-on-Tyne, August 1863.

dredging expedition to the Dogger Bank, under the auspices of the British Association.

I have now to increase this list by the addition of ten species, seven of which are new to science, and three new to Britain.

The new species are contained in the following genera:—

Ammothoa, a genus not before represented by any British form.

Achelia, a new genus which I found it necessary to establish.

Pallene and *Phoxichilidium*.

The genus *Ammothoa* is in some respects like *Nymphon*, the most decided difference being the greater number of joints of the palpi, *Ammothoa* possessing eight*, whilst *Nymphon* has only five. The footjaws in *Nymphon* are always as long as or longer than the rostrum; in *Ammothoa* they are much shorter.

I have two new species to describe, for which the specific names of *brevipes* and *longipes* are proposed.

Ammothoa brevipes (Hodge). Pl. XII. figs. 1–4.

Limbs short and robust, furnished with moderately long, strong spines. Rostrum conical, with the apex truncate. Footjaws nearly two-thirds the length of the rostrum; palpi equal in thickness throughout,—if anything, slightly thicker at the free end. Oculiferous tubercle terminating in a pointed wart directed backwards. Abdomen long, slightly tapering.

Several specimens have occurred on the Durham coast, from deep water. Length $\frac{1}{10}$ of an inch.

Ammothoa longipes (Hodge). Pl. XII. figs. 5, 6.

Animal slender. Rostrum stout, as long as the thorax, tapering to a blunt point. Palpi long and slender, the four terminal joints of equal length. Footjaws long; fingers destitute of teeth. Oculiferous tubercle slightly tapering.

A single specimen from Polperro. Length $\frac{1}{10}$ of an inch.

Achelia is distinguished by the possession of two pairs of palpi—one pair long and slender, the other short and stout. The genus may be thus characterized:—

Antennæ two-branched, one pair long and slender, eight-jointed; the other pair short and stout, two-jointed, and produced immediately in front of the oculiferous tubercle.

In some respects this genus agrees with a form possessing two pairs of palpi, which Kröyer named *Zetes*; it may, however, at once be distinguished by the very different character of the

* The foreign forms are said to possess nine.

rostrum,—*Zetes* being much elongated and seated upon a sort of stalk, *Achelia* being short and stout.

I have three species of this genus to describe, for which the specific names of *echinata*, *hispida*, and *lævis* are proposed.

Achelia echinata (Hodge). Pl. XII. figs. 7–10.

*Animal robust, with moderately long legs, furnished with strong spines produced from little eminences upon the limbs and body. The oculiferous tubercle is directed forwards, and terminates in a little point directed backwards. Inner palpi of the same length as the oculiferous tubercle; the outer longer than the rostrum. Colour fine sienna to a pale straw.

This species has been found at the Channel Islands, the Isle of Man, and upon the Durham coast. It is by no means uncommon from low tide to a few fathoms. Length $\frac{7}{10}$ of an inch.

Achelia hispida (Hodge). Pl. XIII. fig. 11.

Animal robust, hairy. Limbs long, first four joints much stouter than the others. Thorax much produced in front. Inner palpi large and stout, with a circlet of little spines at the base and at the top of the first joint; outer palpi longer than the rostrum. Oculiferous tubercle scarcely reaching beyond the origin of the inner palpi.

Several specimens from Polperro. Length $\frac{8}{10}$ of an inch.

Achelia lævis (Hodge). Pl. XIII. fig. 12.

Animal robust. Limbs smooth and regular in form, with a few small hairs scattered over them, principally on the femoral and tarsal joints. Inner palpi rather long, slender; outer palpi as long as the rostrum. Oculiferous tubercle small, produced considerably behind the inner palpi.

Several specimens from Polperro. Length $\frac{1}{10}$ of an inch.

Phoxichilidium virescens (Hodge). Pl. XIII. figs. 13–15.

Rostrum stout, slightly thickened in the middle, truncate at the apex. Footjaws slender, and closely approximated at their origin, each finger with 6–8 teeth. Legs moderately long. Colour pea-green.

Several specimens from Polperro. Length $\frac{7}{10}$ of an inch.

This species might at first sight be mistaken for *Phoxichilidium olivaceum* (Gosse); but the closely approximated footjaws at once show its distinct character.

Pallene pygmæa (Hodge). Pl. XIII. figs. 16 & 17.

Thorax robust. Legs long and slender, constricted at the joints, last joint falciform, with a strong toothed shoulder at the base; two strong spines on the sixth joint. Rostrum short, stout. Footjaws closely approximated. Oculiferous tubercle moderately long. Abdomen stout.

This species was taken by Mr. Spence Bate in the neighbourhood of Plymouth, so far back as 1853, and by him noticed in a paper of that year, read before the British Association at Hull. It was, however, neither named nor described, his remarks bearing upon the larval stages of these animals. I have also taken a single specimen upon the Durham coast. Length $\frac{1}{16}$ of an inch.

The three species new to Britain all belong to the genus *Nymphon*. They were described by Krøyer in Gaimard's Scandinavian 'Voyage.' One species (*Nymphon Strömii*) has been taken in Shetland by the Rev. A. M. Norman; the other two (*Nymphon mixtum* and *N. longitarse*) have been taken by myself on the Durham coast.

The following list contains all the species at present recorded as inhabiting the British seas:—

Nymphon, *Fabricius*.

- *gracile*, *Leach*.
- *grossipes*, *Fabricius*.
- *femoratum*, *Leach*.
- *pictum*,
- *giganteum*, *Johnston*.
- *longitarse*, *Krøyer*.
- *mixtum*, *Krøyer*.
- *Strömii*, *Krøyer*.
- *hirtum*, *Fabricius*.
- *brevitarse*, *Krøyer*.
- *Johnstoni*, *Goodsir*.
- *spinosum*, *Goodsir*.
- *pellucidum*, *Goodsir*.
- *simile*, *Goodsir*.
- *minutum*, *Goodsir*.
- *brevirostre*, *Hodge*.
- Ammothoa*, *Dana*.
- *brevipes*, *Hodge*.
- *longipes*, *Hodge*.

Achelia, *Hodge*.

- *echinata*, *Hodge*.
- *hispidata*, *Hodge*.
- *lævis*, *Hodge*.
- Pallene*, *Johnston*.
- *brevirostris*, *Johnston*.
- *circularis*, *Goodsir*.
- *pygmæa*, *Hodge*.
- Phoxichilidium*, *M.-Edwards*.
- *coccineum*, *Johnston*.
- *globosum*, *Goodsir*.
- *olivaceum*, *Gosse*.
- *petiolatum*, *Krøyer* (*Pallene attenuata*, *Hodge*).
- *vireacens*, *Hodge*.
- Pasithoë*, *Goodsir*.
- *vesiculosa*, *Goodsir*.
- Phoxichilus*, *Latreille*.
- *spinosus*, *Montagu*.
- Pycnogonum*, *Fabricius*.
- *littorale*, *Ström*.

There can be little doubt that a careful examination of the species found on various parts of our coast would add many new forms to this list, especially amongst the smaller species.

Whilst most departments of marine zoology have made rapid strides within the last few years, our knowledge of the Pycnogons has scarcely advanced. No doubt this is owing, in a great mea-

sure, to the difficulty of determining the species, in consequence of there being no complete list. It is hoped that the foregoing may in some degree supply this want, and lead to these animals being better known and understood.

EXPLANATION OF THE PLATES.

PLATE XII.

- Fig. 1. *Ammothoa brevipes*.
- Fig. 2. Ditto, footjaw.
- Fig. 3. Ditto, tarsus, &c.
- Fig. 4. Ditto, side view.
- Fig. 5. *Ammothoa longipes*.
- Fig. 6. Ditto, tarsus, &c.
- Fig. 7. *Achelia echinata*.
- Fig. 8. Ditto, side view.
- Fig. 9. Ditto, rostrum, palpi, and oculiferous tubercle.
- Fig. 10. Ditto, tip of false foot of female.

PLATE XIII.

- Fig. 11. *Achelia hispida*.
- Fig. 12. *Achelia levis*.
- Fig. 13. *Phoxichilidium virescens*.
- Fig. 14. Ditto, footjaws.
- Fig. 15. Ditto, tarsus, &c.
- Fig. 16. *Pallene pygmaea*.
- Fig. 17. Ditto, tarsus, &c.

XIV.—On the Climbing Habits of *Anabas scandens*. By Capt. JESSE MITCHELL, of the Madras Government Central Museum.

THE following remarks on the *Anabas scandens* will be found at page 295, vol. iii., of the Rev. J. G. Wood's 'Illustrated Natural History,' published by Messrs. Routledge & Co. last year:—

"Some writers say this fish is capable of climbing palm-trees in search of the water that lodges between the bases of the dead leaves and the stem; but this account is now held unworthy of belief."

My object in writing this paper is to show that this account is not unworthy of belief, and that, however strange and unnatural it may appear, the *Anabas scandens* does in reality ascend palm-trees; but I am not prepared to say that it goes in search of water. Yet who knows? The fish may be enough of an epicure to prefer the pure rain-water to the muddy water found in the pools and streams after heavy monsoon rain; for it is at such times it is said to take this wonderful journey. But to my evidence.

A short time ago I was putting up a few freshwater fish to be

sent to Dr. Günther, of the British Museum, and among them were some specimens of *Anabas scandens*. I had directed my assistant, Mr. Rungasawmy Moodeliar, to prepare a list, giving only the Tamil names of the fish, and leaving a column for remarks. On examining this list, I observed opposite to 'Panai yéri' (the *A. scandens*) the entry—"This fish climbs palm-trees." On inquiring whence he had obtained this information, he replied that he had himself seen the fish ascend the palm-tree, and he described what he had witnessed. I asked him to put his statement in writing, and (with a few verbal alterations, not touching the facts) the following is his account:—

"This fish inhabits tanks or pools of water, and is called Panai yéri, i. e. the fish that climbs Palmyra-trees.

"Where there are Palmyra-trees growing by the side of a tank or pool, when heavy rain falls and the water runs profusely down their trunks, this fish, by means of its opercula, which move unlike those of other fish, crawls up the tree sideways to a height of from 5 to 7 feet, and then drops down.

"Should this fish be thrown upon the ground, it runs or proceeds rapidly along in the same manner (sideways), so long as the mucus on it remains."

By "sideways" my informant means that the fish, when climbing or moving on the ground, inclines the body considerably from the vertical; and this seems necessary to enable it to use the spines on the operculum to the best advantage.

I would here remark that the operculum of *Anabas scandens* has greater mobility than that of any fish that I can remember; and this was noticed by Cuvier (*Histoire Naturelle des Poissons*, tome vii. p. 249 of the 4th edition). It can be raised or turned outwards to nearly a right angle with the body; and when it is in that position, the suboperculum descends a little; and it appears to me that it is chiefly by the spines of this latter piece that the fish takes a purchase on the tree or on the ground. I have ascertained by experiment that the mere closing of the operculum when the spines are in contact with any surface, even common glass, pulls an ordinary-sized fish forwards about half an inch; but it is probable that additional force is supplied by the caudal and anal fins, both of which it is said are put in use when climbing or advancing on the ground: the motion, in fact, is described as a wriggling one.

One of my taxidermists has also informed me that in his boyish days he had frequently seen the Panai yéri ascend Palmyra-trees at Negapatam (now the terminus of the Southern India Railway). I should have said before, that Mr. Rungasawmy's observations were made about six years ago, in the neighbourhood of the Red Hills in the vicinity of Madras.

For myself, I am perfectly satisfied with the evidence, both verbal and written, that has been given to me. It will be seen that it is substantially the same as that given by Daldorf and John, who, however, did not notice (or, if they did, did not record) that the fish inclined its body to one side when advancing by means of its opercula. To me, the fact that the *negative* evidence of Buchanan Hamilton should have been considered of more value than the *positive* evidence of two eye-witnesses (one a highly respectable missionary, the other an officer in the Danish service) is a thing more extraordinary by far than that the *Anabas scandens* should ascend palm-trees, for which one might almost say it is specially fitted by the unusual form of its opercular pieces.

That Hamilton Buchanan never saw this fish climb a Palmyra-tree is by no means surprising; for it is said only to do so during the monsoon, when the trees are surrounded by water, and the rain is descending their trunks—a time when, save by the merest accident, no European, unless for some special reason, is likely to be in such a situation. Buchanan Hamilton was from Bengal, and in all probability knew nothing of the Tamil language; if he had, it might have occurred to him that the common Tamil name of this fish must have been given for some good reason.

Madras, Nov. 13, 1863.

XV.—*Observations on Raphides*. By GEORGE GULLIVER, F.R.S.

[Continued from p. 43.]

Rubiaceæ.—We have seen how, in our native Flora, the plants of this order may be characterized as raphis-bearers. Though Prof. Babington retains the name of *Rubiaceæ* in his 'Manual of British Botany,' these weeds have been separated by very high authority (see Lindley's 'Vegetable Kingdom') from the useful and larger group of *Cinchonaceæ*; so that Prof. Lindley's order *Galiaceæ* includes all the British species of *Rubiaceæ*, and he abolishes this last name altogether. Of *Cinchonaceæ* I am now enabled, through the courtesy of Dr. Hooker, to give the following results of a few examinations:—*Ixora* (fresh leaves of four species), no raphides; but abounding in beautiful sphæraphides, each about $\frac{1}{1800}$ th of an inch in diameter. *Gardenia* (fresh leaves of two species), no raphides; but loaded and somewhat gritty with sphæraphides, larger than those of *Ixora*, and well seen in sections of the petioles. *Manettia bicolor* and *Pentas carnea* (fresh leaves and interpetiolar stipules) abounding in

bundles of raphides. Thus raphides are plentiful in the two herbaceous species, and are replaced or represented by sphæraphides in the two shrubby plants. I have elsewhere (Quart. Journ. Microsc. Sc. for Jan. 1864) noticed the scarcity of raphides and abundance of other crystals in trees and shrubs.

Araceæ.—Prof. Balfour has for many years used the ovaries of *Arum* for furnishing raphides to the pupils of his histological class, and Dr. MacLagan found these raphides to consist of oxalate of lime. The question of the composition of raphides is very important, and requires further research. They have often been described as a form of phosphate of that earth. Their abundance in the root of *Smilacæ* led me to look for them in the officinal extract of Sarsaparilla, in which no raphides could be found, though it contained numerous minute square crystals, some of which were distinctly seen to be such quadratic octahedrons as are commonly formed of oxalate of lime. The difference between the raphis-cell and its surrounding cells is well depicted in fig. 38 of Prof. Balfour's 'Manual of Botany.' Prof. George Lawson, of Canada, informed me that while he acted as histological demonstrator in Prof. Balfour's class at Edinburgh, several years before 1859, he was frequently in the habit of employing *Lemna trisulca* for the purpose of showing raphidian cells*.

Constancy of the Raphis-bearing character.—Raphides are produced, as we have before shown, in all stages of the growth of typical raphis-bearing plants, from the ovule to the seed-leaves, thence through the ascending and descending axes, and the appendages of the former and their modifications to the fruit. So little effect has either the soil or the situation in which the species flourishes on this important function of raphis-bearing, that it will continue as regularly during the entire vigorous existence of the plant as any common phenomenon of whatsoever kind in the cell-life of that plant. But though these conclusions are deduced from observations extending over the spring, summer, and autumn of several years, and sometimes on plants from various and dissimilar localities, the state of the raphides in the winter season was seldom inquired into. Hence I have repeated the examinations of such plants as could be easily procured be-

* I have recently learned that Prof. Balfour long since observed the abundance of raphides in various *Araceæ*, as *Colocasia odora*, *Richardia æthiopica*, and *Caladium viviparum*. Prof. Douglas MacLagan discovered the raphides in the ovary of *Richardia*, subjected them to chemical analysis, and found them to consist of oxalate of lime. He looked at those of *Arum*, and concluded that they also are oxalate of lime (Trans. Bot. Soc. 1861; Edinb. New Phil. Journ. new ser. xvi. 300). The raphides of *Lemna trisulca*, which Dr. Lawson was the first to use in the class demonstrations, were noticed in Prof. Balfour's 'Class-Book of Botany,' ed. 1855, p. 41.

tween the 13th and 31st of December last, and of which every species had been proved by my former observations regularly to abound in raphides during the genial months. The following extracts from my note-book will be sufficient examples of several others to the same effect:—“*Eucharidium grandiflorum*, *Godetia vinosa*, *Clarkia elegans*, and *C. pulchella*: raphides abundant in the seed-leaves and other parts of young plants, also in the roots and dead and living leaves and branches and capsule-valves of exhausted and decaying plants. *Epilobium hirsutum* and two other common species: raphides very abundant in the roots, in the dead stems and pith, in the dead leaves and capsules, and in the small living buds of the subterranean stems. *Asperula odorata*: raphides in root and its fibrils, and in living and dead stems and leaves; the root very rich in starch-cells full of granules. *Galium Aparine* (young growing seedlings): raphides small and tender throughout the plant, more abundant in the seed-leaves, least so in the fibrous root; plentiful also, with dotted vessels, in the dead, withered stems of old plants of last season. *Galium Mollugo*: a few raphides in the dry fruit, and bundles of them swarming in the liber of the creeping woody root, but less abundant in its fibrils and in the young shoots and leaves; the raphides in the old root larger and stronger than those in the leaves and stem of the young shoots; central part of root chiefly made up of dotted vessels, the dots thickly studded, about $\frac{1}{1000}$ th of an inch in diameter, and without the least appearance of their being the remains of annular stripes; no starch in the root. *Tamus communis*: raphides abounding in the root and its buds, and in the pulp of the berry; root chiefly made up of starch. *Asparagus officinalis*: raphides plentiful in the root. *Lemna minor*: raphides numerous.”

In short, my observations generally are to the effect that, whenever raphides afford a diagnostic, as I have proved they often do, it is more fundamental and universal than any other single one yet employed in botanical classification: fundamental, because it is an essential part of the nature of the plant from its very birth; universal, because this character is so widely diffused that it will be found, as above described, throughout the general system, and during the whole life and after the death of that plant. Thus, at any or every season and state of growth, either a young fresh seed-leaf or a bit of a living or dead leaf or stem, or root or berry-pulp, may be sufficient for the diagnosis in question, between plants of two closely allied orders.

Edenbridge, January 1864.

[To be continued.]

XVI.—On the Menispermaceæ.

By JOHN MIERS, F.R.S., F.L.S. &c.

[Continued from p. 15.]

WITH the view of assisting the recognition of the plants of this family, the following synopsis is offered of the distribution of the genera, which will be separately described in the same order.

SYNOPSIS GENERUM MENISPERMACEARUM.

- Tribus 1. HETEROCLINIEÆ.** Embryo fere rectus, cotyledonibus foliaceis, divaricatis, intra locellos albuminis copiosi hinc ruminati inclusis, radícula parva, tereti, supera. Condylus diversiformis, internus, vel fere obsoletus.
- Cotyledones irregul. laciniati; condyl. globos. 2-camerat. 1. *Coscinium*.
- Cotyledones integri.
- Stamina libera.
- Stam. 12 (6 inter. longiora); antheræ introrsæ; condyl. umbiform. concav. 2. *Calycocarpum*.
- Stam. 6; anther. longit. dehisc.; condyl. umbiform. concav. 3. *Jateorhiza*.
- Stam. 6; anther. transv. dehisc.; condyl. globos. 2-camerat. 4. *Tinospora*.
- Stam. 6; filam. dilat. memb.; condyl. globos. 2-camerat. 5. *Chasmanthera*.
- Stam. 6; filam. petal. coalit.; condyl. e plica longit. valde intrus. 6. *Fibraurea*.
- Stam. 6; filam. clav. incurv.; condyl. e sulco longit. obsolet. 7. *Tinomiscium*.
- Stam. 6; filam. brev. incrass. 8. *Burasia*.
- Stamina monadelphæ.
- Antheræ 15–40, recept. globos. sessil. coalit.; condyl. globos. 2-camerat. 9. *Anamirta*.
- Antheræ 6, in caput. aggreg., filam. gracil. suffult.; condyl. umbiform. concav. 10. *Parabæna*.
- Antheræ 6, peltat. affixæ; filam. columnar.; condyl. umbiform. obsolet. 11. *Aspidocarya*.
- Stamina 6; filam. ad medium coalit.; condyl. umbiform. concav. 12. *Odontocarya*.
- Stamina ignota; putamen echinat.; condyl. magn. scutiform. 1-camerat. 13. *Rhigiocarya**.
- Tribus 2. ANOMOSPERMEÆ.** Embryo tenuis, teres, intra albumen copiosum undique ruminatum inclusus, cotyledonibus accumbentibus, incurvatis aut fere rectis; radícula brevissima, ad summum spectante. Condylus internus, verticalis, laminiformis. Sepala æstivatione valde imbricata.
- Petala 6, stamina amplectentia 14. *Anomospermum*.
- Tribus 3. TILIACOREÆ.** Embryo teres, tenuiter elongatus, hippocrepe curvatus, intra albumen copiosum undique ruminatum centralis, cotyledo-

* *Rhigiocarya racemifera*. Riv. Quorra (Barter, 3325).

nibus teretibus, incumbentibus; radícula tereti, iis 2-plo brevior, ad stylum fere basalem spectante. Condylus internus, horizontaliter septiformis. Sepala aut subvalvata, aut subimbricata.

- Petala 6. Sepala valvata. Stam. glabra. Drupæ 3-12, stipitatae et carpoph. long. suffult. 15. *Tiliacora*.
 Petala 0. Sepala valvata. Stam. glabra. Drupæ 3, tomentos. brev. stipitat. 16. *Abuta*.
 Petala 0. Sepala valvata. Stam. hirsut. Drupæ 3, tomentos. brev. stipitat. 17. *Batschia*.
 Petala 0. Sepala subimbric. Stam. glabra. Drupæ 3, glabræ, brev. stipitat. 18. *Anelasma*.

Tribus 4. *HYPSPERPEÆ*. Embryo teres, tenuiter elongatus, intra albumen simplex cyclice curvatus, cotyledonibus accumbentibus, radícula iis æquilonga, ad stylum fere basalem spectante. Condylus externus, subglobosus.

- Sepal. 8-12, inter. imbric. Petal. 5-6-8. Stam. 6-8-10. Ovaria 3-6 19. *Hypserpa*.
 Sep. 6-9, inter. valvat. Pet. 6. Stam. 6. Ovar. 3 20. *Limacia*.

Tribus 5. *LEPTOGONÆ*. Embryo teres, tenuiter elongatus, intra albumen parcum simplex cyclice curvatus, cotyledonibus incumbentibus, radícula iis æquilonga aut 2-plo longior, ad stylum fere basalem spectante. Condylus externus, globosus, vel peltiformis, varie elaboratus. Sepala imbricata.

Subtribus 1. *Menispermeæ*. Stamina distincta vel imperfecte monadelphæ.

- ♂ Petala 6 vel 0. Stam. 12-18, libera. ♀ Petala 6 21. *Menispermum*.
 ♂ Petala 6. Stam. 6, libera. ♀ Petala 6, cuneato-auriculata 22. *Pericampylus*.
 ♂ Petala 6. Stam. 6, basi coalita 23. *Pselium*.
 ♂ ignot. ♀ Petala 3 24. *Ileocarpus*.
 ♂ ignot. ♀ Petala 4 25. *Homocnemis*.

Subtribus 2. *Cissampelideæ*. Stamen 1, centrale; filamentum columnare; antherarum loculi peltatim affixi.

- ♂ Sepal. 1, campanul. Pet. 1, campan. Anth. loc. 6, peltat. coalit. 26. *Rhaptomeris*.
 ♂ Sepal. 4, libera. Pet. 1, poculif. Anth. loc. 4-12, pelt. coalit. ♀ Pet. 1 27. *Cissampelos*.
 ♂ Sepal. 4, libera. Pet. 1, poculif. Anth. loc. 4, pelt. coalit. ♀ Pet. 2 28. *Antisoma*.
 ♂ Sepal. 4, valvat. Pet. 4, valvat. Anth. loc. 4-8, pelt. coalit. 29. *Clypea*.
 ♂ Sepal. 6, libera. Pet. 3. Anth. loc. 6, pelt. coalit. 30. *Stephania*.
 ♂ Sepal. 6, libera. Pet. 6. Anth. loc. 6, pelt. coalit. 31. *Clambus**.
 ♂ Sepal. 8, libera. Pet. 4. Anth. loc. 4, conglobat. 32. *Cyclea*.

Tribus 6. *PLATYGONÆ*. Embryo intra albumen parcum, simplex, hippocrepiformis aut cyclice

* *Clambus araneosus*, Mexico (Pavon).

curvatus, cotyledonibus foliaceis, incumbentibus, radícula tereti, iis 2-10-plo brevior, ad stylum fere basalem spectante. Condylus externus, aut septiformis, vel subglobosus. Sepala imbricata.

- ♂ Petal. 6, emargin. imo involut. Stam. 6, distinct. Condyl. globos. 2-camer. ext. perforat. 33. *Cocculus*.
 ♂ Pet. 6, bifid. lacin. acutiss. Stam. 6, distinct. Condyl. globos. 2-camer. ext. perforat. 34. *Nephroica*.
 ♂ Pet. 6, bifid. lacin. obtus. Stam. 6, distinct. Condyl. globos. 2-camer. ext. perforat. 35. *Holopeira*.
 ♂ Pet. 6, cuneat. auric. ap. dentat. Stam. 6, distinct. Condyl. septiform. 36. *Diplocisia*.

Tribus 7. PACHYGONÆ. Embryo exalbuminosus, hippocrepice vel cyclice curvatus, cotyledonibus valde crassis, accumbentibus, radícula brevi, tereti, ad stylum fere basalem spectante. Condylus externus, septiformis, vel subglobosus, aut fere obsoletus.

- ♂ Petala 6. ♀ Ovar. 3. Cotyled. hippocrep. Condyl. septiform. 37. *Hyperbæna*.
 ♂ Petala 6. ♀ Ovar. 6. Cotyled. hippocrep. Condyl. septiform. 38. *Chondodendron*.
 ♂ Petal. ignot. ♀ Ovar. 3. Cotyled. hippocrep. Condyl. septiform. 39. *Hæmatocarpus*.
 ♂ Petal. 6. ♀ Ovar. 3. Cotyled. hippocrep. Condyl. subpeltiform. 40. *Pachygone*.
 ♂ Petal. 6. ♀ Ovar. 6. Cotyled. cyclic. Condyl. umbiform. 41. *Pleogyne*.
 ♂ Petal. ignot. ♀ Ovar. 9. Cotyled. cyclic. Condyl. umbiform. Carpoph. elong. 42. *Sciadotenia*.
 ♂ Petal. 0. ♀ Ovar. 3. Cotyled. incurv. radic. gigant. Condyl. obsolet. 43. *Triclisia*.
 ♂ Petal. 6. ♀ Ovar. 3. Cotyled. incurv. radic. minima. Condyl. obsolet. 44. *Pycnarrhena*.
 ♂ Petal. ignot. ♀ Ovar. 3. Cotyled. ignot. Condyl. obsolet. 45. *Sarcopetalum*.

Genera incertæ tribus (fructu ignoto).

Stamina monadelphæ.

- Sepal. 9-12. Petal. 6. Stam. 3, ultra med. coalit. 46. *Detandra**.
 Sepal. 6. Petal. 0. Stam. 3, ad med. coalit. Stamina libera. 47. *Syrrhonema*†.
 Sepal. 4, imbric. Petal. 2. Stam. 4. Anth. 1-lob. transv. hiant. 48. *Antitaxis*.
 Sepal. 6, imbric. Petal. 6. Stam. 6. Anth. 2-lob. transv. hiant. 49. *Elissarrhena*‡.
 Sepal. 12, imbric. Petal. 6. Stam. 6. Anth. 2-lob. connectiv. galeat. 50. *Baterium*§.
 Sepal. 9; 3 coalit. valv. Petal. 6. Stam. 9; 3 lib. 6 monadelph. Anth. 2-lob. diagon. hiant. 51. *Synclisia*.
 Sepal. 9, imbric. Petal. 6. Stam. 6, Anth. 2-lob. Ovar. 3. Stigm. magn. 52. *Penianthus*||.
 Sepal. 5. Petal. 5. Stam. 5. 53. *Quinium*.

* *Detandra latifolia* et *ovata*. Both from Bahia (Blanchet. id. 3178).

† *Syrrhonema fasciculatum*. Fernando Po (Mann, 192).

‡ *Elissarrhena longipes*. Rio Negro (Spruce, 1538).

§ *Baterium validum*. Khasya (Griffiths).

|| *Penianthus longifolius*. Fernando Po (Mann, 194).

Genera dubia, vel ab ordine excludenda.

Adeliopsis, Bth. & Hook. (Gen. Pl. i. 436). In each of its three carpels there are two superimposed ovules—a character quite foreign to *Menispermaceæ*, and more in conformity with *Schizandraceæ*.

Spirospermum, Th. Although admitted in the new 'Genera Plantarum' (i. 39), the genus cannot belong to this order: if the mode of development of the ovary in *Menispermaceæ* be as I have described it (of which little doubt can be entertained), no embryo by any possibility could ever become "cylindricus, longissimus, spiralter convolutus." This structure recalls to our memory the Sapindaceous genera *Ophiocaryum*, *Llagunoa*, and *Guindilla* (*Valenzuelia*), the latter a dioecious or polygamous plant from the Andes of Chile, having three distinct unilocular carpels, attached to a short slender gynobase, each containing an exalbuminous seed with a spiral embryo. The position of *Spirospermum* will more probably be found in *Sapindaceæ* or *Ochnaceæ*.

It may here be remarked that the *Chondodendron* of the new 'Genera Plantarum' (non R. & P.) is identical with my genus *Odontocarya*; and that my *Botryopsis* is the same as *Chondodendron*, R. & P., which name claims the preference. *Microlicia* of the same work is synonymous with my *Pleogyne*. *Sarcopetalum* of the same authors belongs to the tribe *Pachygoneæ*.

1. COSCINIUM.

This genus was first proposed by Colebrook for a Ceylon plant (the *Veni-vel* of the natives), the seed of which had been figured by Gaertner as the *Menispermum fenestratum* (De Fruct. i. 219, tab. 46. f. 5). Colebrook's account of the typical plant is very incomplete, as he had not seen either the male or the female flowers, all his data being founded on a short memorandum of Dr. Roxburgh. Gaertner represents the cotyledons of the embryo as being pierced with holes, whence his specific name of *fenestratum*; but in this respect he was undoubtedly mistaken: that excellent carpologist (perhaps from imperfect specimens) quite misunderstood the whole seminal structure; his drawing shows the radicle in the usual position, diametrically contrary to the base of the seed, instead of being directed to a point near it; the cotyledons, though in different cells of the albumen, are shown to be accumbently placed together, not laterally divaricated, and to be pierced with holes, instead of being deeply lacinated on their margins; while the extremely gibbous form of the drupe is not noticed. The drupe is oval, and transverse in regard to its stipitate support, the remains of the style being seen in one of its angles, at a point removed 30° from the base; but as the stipitate support stands at a right angle with the axis of the pedicel, the longer diameter of the fruit is parallel with that axis, so that the style, at the distance mentioned, points towards it. The putamen is correspondingly oval, somewhat flattened on the side of the stipitate support, nearly opposite to which are seen two small collateral pervers

holes, opening into cavities of the internal condyle, which forms a globular expansion on that side within the cell, and upon which the hollow fungilliform seed is moulded. The embryo is situated on the opposite or dorsal side, beneath an extremely thin coating of simple albumen, which is convex on that face, while it is extremely concave, very thick, and deeply cleft all over the opposite side, the thin integuments entering into its numerous anfractuositities. The embryo therefore partakes of the convexity of the dorsal side, its small terete radicle pointing to that part of the cell opposite to the style; while its large cotyledons, of very delicate texture, are divaricately separated on the same plane, deeply lacinated all along their margins, and enclosed in cells of the albumen of corresponding form. In analyzing this seed, the greatest care is necessary in removing the thin plate of albumen which covers the embryo; and it requires a previous knowledge of its position in order to extract it entire, as the force required to break away the albumen, which is solid between the sinuosities of the lacerations of the cotyledons, is likely to injure it,—a caution that is requisite in examining the seeds of the whole of the *Heterocliniæ*.

The authors of the 'Flora Indica' place this genus in a distinct tribe (*Coscinieæ*), on the ground that its petals are larger than the sepals, and that the structure of the seed is different from that of the *Heterocliniæ*; but in this they have considered the three inner sepals as petals, and they have relied upon Gaertner's erroneous figure and description of the seed, not choosing to place faith in my more accurate analysis, to which they allude*. It will be seen that there is nothing in the structure at variance with all the other genera of the *Heterocliniæ*, except in the lacerated margins of the cotyledons: there are therefore no grounds to justify the retention of the *Coscinieæ* as a distinct tribe, which view has been confirmed by the authors of the 'Genera Plantarum,' who now reject it. The inner row of sepals, considered as petals by the before-mentioned botanists, differ in no respect in their form and appearance, except in size, from the more external rows—a circumstance of uniform occurrence throughout the order. In *Abuta* we have exactly the same number and arrangement of floral envelopes as in *Coscinium*, and they have always been considered as sepals, which is proved by the existence of the ordinary form of scale-like petals in *Tiliacora*, where all the other floral envelopes correspond with those of *Abuta*. We may therefore conclude that in *Coscinium*, as in

* After the publication of the 'Flora Indica,' I obtained, through the kindness of Sir W. Hooker, fresh drupes of *Coscinium*, by which my previous analysis of seeds given me by Prof. Lindley was completely confirmed.

Abuta, *Batschia*, *Anelasma*, *Triclisia*, and *Syrrhonema*, the petals are altogether wanting, as they are apparently deficient in *Fibraurea*, and also absent in the male flowers of *Calycocarpum*.

Coscinium is exclusively an Asian genus, generally inhabiting the islands of the Indian Archipelago. Its species are all climbing plants, with very large, thick, coriaceous, coarsely nerved leaves, which are generally covered beneath with thick tomentum: they are oblong, sometimes peltate, in other cases peltate, and supported by long and very strong petioles, which are tumid and tortuous at both extremities.

COSCINIUM, Coleb. Pereira, Lindl.—*Flores* dioici. *Masc. Sepala* 9 (imo bracteis 2 donata) in ordine ternario alternatim disposita, quorum 6 interiora majora, spatulato-ovata, valde carnosæ, intus glabra, extus sericeæ, æstivatione imbricata, demum subrotatim expansa. *Petala* nulla. *Stamina* 6, biserialia, androceo cylindrico affixa: *filamenta* carnosæ, 3 exteriora libera, apice reflexa, 3 interiora alterna, erecta, ad medium monadelphæ, sepalis interioribus opposita: *antheræ* exteriorum introrsæ, 1-lobæ; interiorum subextrorsæ, 2-lobæ, lobis sejunctis, utrinque lateralibus; omne apice filamentis dorso affixæ, et semiimmersæ, 2-locellatæ, 2-valvatæ, valvis rima longitudinali hiantibus. *Ovarii* rudimentum nullum. —*Fœm. Sepala* maris; *petala* nulla; *stamina* 6, sterilia, gynæceo affixa; *ovaria* 3, gibboso-ovata, gynæceo columnari insita, 1-locularia, 1-ovulata. *Stylus* tenuis, brevis. *Stigma* recurvum (sec. Roxb.). *Drupe* 3, vel abortu pauciores, gibbosæ, subovales v. globosæ, carnosæ, tomentosæ, stipite crasso brevi suffultæ, stylo in angulo versus basin notatæ, 1-spermæ: *putamen* ovatum, osseum, crassum, 1-loculare, dorso convexius, sutura peripherica vix conspicua; *condylus* internus, ventralis, majusculus, globosus, in loculo longe protensus, 2-cameratus, foraminibus 2 extus perforatus: *semen* loculo conforme, meniscoideo-globosum, facie ventrali valde cavum, hinc condylum amplexans, et ei *raphe* longitudinali affixum; *integumenta* tenuiter membranacea, intra plicaturas albuminis insinuata: *embryo* paulo convexus, intra *albumen* amplum carnosum quasi 2-laminare inclusus, lamina externa tenui, interna valde crassa et in lobos plurimos convolutoplicatos undique profunde ruminata; *cotyledonibus* tenuissime foliaceis, valde expansis, undique profunde sinuato-laciniatis, lateraliter divaricatis, et in locellis albuminis utrinque inclusis; *radicula* brevissima, tereti, ad stylum spectante.

Frutices scandentes, in India Orientali et insulis propinquis indigeni: folia magna, longe petiolata, oblonga, peltata vel palata, 5-7-nervia, crasso-coriacea, supra glabra, subtus tomentosa:

racemus ♂ *supra-axillaris*, *petiolo brevior*; flores *minuti*, in *capitulis pedunculatis sessiles*, et *dense aggregati*, *omnino cano-tomentosi*.

1. *Coscinium fenestratum*, Coleb. Linn. Trans. xiii. 51; Flor. Ind. i. 178;—*Menispermum fenestratum*, Gaertner, Fr. i. 219, tab. 46. f. 5; *Roxb. Fl. Ind.* iii. 809; *DC. Syst.* i. 541, *Prodr.* i. 103;—ramulis teretibus, striatis, ferrugineo-tomentosis; ♂ foliis palatis, rotundato-ovatis, imo truncatis et 2-sinuatis, in lobo medio anguste cordatis, apice breviter et subito lineari-attenuatis, ad marginem sæpe acute ac breviter lobatis, 5-nerviis, crasso-coriaceis, supra lucidis, planis, in nervis sulcatis, sub lente tenuissime reticulatis, subtus fulvo vel cano-tomentosis; nervis crassis extus ramosis venisque transversis prominentibus; petiolo longo, ferrugineo-tomentoso, imo tortuoso et incrassato; racemo supra-axillari, tomentoso, petioli tertia parte longitudinis; ramis plurimis, longis, divaricatis, apice capitulatis, capitulis e floribus sessilibus arcte aggregatis: ♀ foliis subpeltatis, deltoideo-ovatis, acutis, acumine lineari-attenuatis, imo truncatis, aut vix cordatis, ad marginem plus minusve lobatis, lobis rotundatis vel subito valde attenuatis, 5-nerviis (præter alios nervos 4 basales vix conspicuos), supra lucidis; racemo fructifero e pedunculo supraaxillari valido, petioli tertia parte longitudinis, apice subumbellatim pedicellato; pedicellis elongatis, crassiusculis, drupas globosas 3–2–1 breviter stipitatas gerentibus.—Ceylon, *v. s. in herb. Mus. Brit.* (König); *in herb. Lindl.*; *in herb. Champ.* ♂ et ♀.

In König's specimen the leaves are $6\frac{1}{2}$ inches long, $4\frac{1}{4}$ inches broad, the first pair of nerves running nearly parallel with the margin to near the apex, the petiole measuring 4 inches. In Prof. Lindley's plant, the leaves are 7 inches long, $5\frac{1}{4}$ inches broad, on a petiole $3\frac{1}{2}$ inches; here the first pair of nerves sometimes terminates in a short acute lobe. In Major Champion's ♂ plant, the leaves, though much broader and of similar shape at base, are $6\frac{1}{4}$ inches long, $5\frac{3}{4}$ inches broad, on a petiole nearly 3 inches long: in the ♀ plant, the leaves are distinctly peltate, $4\frac{1}{2}$ –5 inches long, 4 inches broad at base, tapering gradually in a sinuous line to an attenuated apex; here the second pair of nerves are often extended into two acute, deep, nearly basal lobes; the petiole is 3 inches long, twisted and tumid at base, and inserted into the blade 2 or 3 lines within the basal margin. In the male plant, the inflorescence is about 1 inch long, with numerous branchlets extending at right angles about $\frac{1}{2}$ an inch long, each terminated by a globular head 2 or 3 lines in diam. In the fructiferous plant the peduncle is strong, 1–2 inches long, terminated by several radiating pedicels 8–9 lines long, each

supporting nearly globular drupes, which are tomentose and $\frac{1}{4}$ inch diameter.

2. *Coscinium Blumeianum*, nob., Ann. Nat. Hist. 2 ser. vii, 37; Fl. Ind. i. 79;—*Cocculus Blumeanus*, Wall.;—ramis petiolisque brunneo velutinis; foliis valde peltatis, lanceolato-oblongis, basi orbicularibus vix cordatis, dehinc gradatim angustioribus, apice repente acutis, 10-nerviis, nervis 2 primis subparallelis et fere ad apicem continuis, crasso-coriaceis, supra nitidissimis, nervis venisque transversis sulcatis, istis subtus valde prominentibus, cum pagina inferiore et petiolo longissimo imo apiceque valde tumefacto dense cano-vel gilvo-tomentosis; racemo supra-axillari petiolo subbreuiore, floribusque sessilibus, dense aggregatis, gilvo-tomentosis; ramis alternis subbreuib, apice globoso-capitatis; sepalis rotato-expansis, superne glabris, flavescentibus, subtus murino-tomentosis.—Penang, v. s. in herb. Soc. Linn. et Hook. ♂ (Wall. Cat. No. 4971 A).

The branches of this very distinct species are clothed with dense floccose tomentum, and are $\frac{1}{2}$ inch diam., with internodes 3 inches apart; the leaves above are very polished, very coriaceous, and below are covered with dense white or yellow tomentum, mixed with a few brown silky hairs; they are 12 inches long, or $10\frac{1}{2}$ inches from the insertion of the petiole, $4\frac{3}{4}$ to $7\frac{1}{2}$ inches broad below the middle, the petiole being nearly 7 inches long, terete, barely a line in diam., but swollen for some length at base to a diam. of 4 lines, and thickened at the apex; other leaves are of the same length, with nearly parallel sides, about $3\frac{1}{2}$ inches broad, suddenly contracted on the margins opposite the insertion of the petiole by a short hollow sinus, and are thus somewhat panduriform, the petiole being 5 inches long. The male raceme, originating at some distance from the petiole, is simple, about 4 or 5 inches long, with ten or fifteen alternate curving pedicels $\frac{1}{2}$ inch long, bearing rounded heads, 4 lines in diam., of crowded sessile flowers.

3. *Coscinium Wallichianum*, nob. loc. cit. p. 37;—*C. fenestratum*, H. & L. in parte Fl. Ind. i. 178;—ramis petiolisque dense fulvo-lanatis; foliis oblongis, acutis, basi obtuse rotundatis et subsinuatis, palaceis, 5-nerviis, crasso-coriaceis, supra omnino glabris, nitentibus, in nervis sulcatis, subtus dense sulphureo-tomentosis; nervis crassis venisque transversis valde reticulatis prominentibus; petiolo imo tortuoso et valde incrassato.—Singapore, v. s. in herb. Soc. Linn., sine flore (Wall. Cat. 4971, sub "*Cocculus Blumeanus*").

The authors of the 'Flora Indica' have considered this to be
Ann. & Mag. N. Hist. Ser. 3. Vol. xiii.

identical with the typical species; Wallich, however, regarded it as distinct from that plant, making it a variety of *C. Blume-anum*. It differs from the latter in its palatate leaves and shorter petioles, and from the former in their oblong and more pointed form, with a different tomentum and shorter petioles. Its claims to rank as a distinct species are strengthened by the consideration of the far-distant country of its origin, and because the two other species are quite local. Its branches are covered with woolly fulvous tomentum, and its leaves, which are gradually narrower from the middle to the apex, are $8\frac{1}{4}$ inches long, 6 inches broad, on a petiole $2\frac{1}{4}$ inches long.

2. CALYCOCARPUM.

This genus was established by Nuttall, in 1838, upon a plant of the Western States of North America, the *Menispermum Lyoni* of Pursh. It is well figured in Gray's 'Genera of the United States,' but the details of the putamen and seed are incomplete. It is a slender climbing plant, having deeply cordate 5-lobed leaves, with sinuated margins, palately fixed upon a long slender petiole; the inflorescence is an axillary, elongated, slender, racemose panicle, nearly as long as the leaf and petiole. It differs from all others of the *Heterocliniæ* in having its male flowers provided with six sepals, no petals, and 12 free stamens in two series; its female flower has six sepals, six small fleshy petals, six sterile stamens, and three or four sessile ovaries, with a very short thick style and a multilacinated spreading stigma. Its drupe contains a meniscoid, orbicular, thin, chartaceous putamen, globose on the dorsal side, with a sharp apical spine; it is concave on the ventral face, furnished on its margin with a number of soft sharp flattened teeth, and along the upper moiety of the ventral face with a carinated longitudinal ridge similarly toothed; the hollow of this face forms a concave scutiform condyle, which protrudes into the centre of the cell, and from its upper part is suspended, by a very short funicle, the deeply meniscoid seed; the embryo is enclosed in the middle of nearly simple albumen, which is marked on the inner face by transverse lines where it is obsoletely ruminated; the small radicle points to the style near the vertex; the cotyledons are flat, foliaceous, oval, greatly divaricated; they partly overlies each other in the upper part, but are widely separated in their lower portion, the albumen being there correspondingly 2-celled to contain them. The genus is therefore marked by very salient characters.

CALYCOCARPUM, Nutt.—*Flores* dioici. *Masc. Sepala* 9, quorum 3 exteriora bracteiformia, 6 interiora multo majora, 2-serialia, subæqualia, spatulato-oblonga, membranacea, æstivatione

imbricata. *Petala* nulla. *Stamina* 12, 4-serialia, libera, quorum 6 sepalis opposita et breviora, 6 interiora longiora et alterna, erecta, longitudine sepalorum; *filamenta* lata, membranacea; *antheræ* 2-lobæ, lobis fere parallelis, dorso affixis, rima longitudinali introrsum dehiscentibus; *ovarii* vestigium nullum.—*Fœm. Sepala* 6, obovata. *Petala* 6, iis opposita, triplo breviora, lineari-oblonga, carnosa, intus profunde canali-formia. *Stamina* sterilia 6, petalis paulo longiora; *antheræ* glanduliformes, effortæ. *Ovaria* 3 vel 4, libera, gynæcio globoso insita, gibboso-oblonga, glabra, 1-locularia; *ovulo* solitario lateri ventrali appenso. *Stylus* brevis, crassus. *Stigma* in lacinias plurimas acutas irregulares radiatas fissum. *Drupæ* 3, globoso-oblongæ, styli vestigio paulo excentrico apiculatæ, carnosæ, glabræ; *putamen* tenuiter chartaceum, meniscoideo-ovatum, dorso globosum, ventre concavum, margine chartaceo in dentes plurimos acutos irregulariter serrato, apiceque spina obliqua armatum, et dehinc carina brevi serrata facie ventrali notatum, 1-loculare; *condylus* subobsoletus, scutiformis, extus concavus, intus valde convexus, et intra loculum protensus; *semen* loculo conforme, meniscoideum, funiculo brevi ex apice condyli suspensum; *integumenta* membranacea, *raphe* longitudinali ventrali non procul ab apice ad basin extensa; *embryo* in *albumine* fere simplici inclusus; *radicula* minima, supera; *cotyledones* ovales, tenuiter foliaceæ, stipitatæ, primo paulo imbricatæ, dein valde divaricatæ et in locellis distinctis albuminis sepultæ.

Frutex scandens America Septentrionalis; folia longe petiolata, profunde 5-loba, marginibus sinuata: paniculæ racemosæ, axillares; ♂ elongatæ, multifloræ; ♀ brevès, paucifloræ.

1. *Calycocarpum Lyoni*, Nutt. in Torr. & Gr. Fl. N. Amer. i. 48; A. Gray, Gen. Unit. St. i. 75, pl. 30;—*Menispermum Lyoni*, Pursh, Fl. Bor. Am. ii. 371; DC. Syst. i. 541;—scandens, ramulis teneribus, striatulis; foliis profunde cordatis, palmatolobatis, lobis 3–5, subæqualibus, subellipticis, acuminatis, margine irregulariter sinuato-dentatis, supra viridibus, subtus flavido-opacis, utrinque sparsim pilosis; petiolo longissimo, glabro, striato, imo tumidulo; panicula racemosa, ♂ folium cum petiolo subæquante; ramis alternis e basi iterumque ramosis, plurifloris; floribus parvis, iridescenti-albis, imo bracteola donatis.—In Alabama, Tennessee, et Kentucky.

In the specimens I have seen, the branches are $1\frac{1}{2}$ line diam., the leaves $5\frac{1}{4}$ inches diam.; the deep lobes, with rounded sinus, are $2\frac{1}{4}$ – $3\frac{1}{2}$ inches long, $1\frac{1}{2}$ inch broad; the petiole is 5 inches long, $\frac{1}{2}$ line thick, palately inserted; the axillary panicle, in form of a slender raceme, is 10 inches long, with branches varying

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from $\frac{1}{2}$ to $1\frac{1}{2}$ inch long, the ultimate pedicels being 1 line long. In the female plant, the leaves are 7 inches diam., the lobes 3–4 inches long; the petiole is $7\frac{1}{2}$ inches long, slender, swollen and tortuous at base; the fructiform raceme is 5 inches long, with eight or nine simple alternate pedicels 3 lines long; drupe 10 lines long, 8 lines diam., semiglobose, obsoletely stipitated at base; putamen as before described.

3. JATEORHIZA.

The root of the typical species on which this genus is founded was known for a very long period in commerce under the name of *Calumba*; but the plant that produced it remained quite in obscurity until Sir William Hooker published his interesting account of it in the 'Botanical Magazine,' tab. 2970, 2971, under the name of *Cocculus palmatus*. On the examination of its male and female flowers, as well as of its seed, I found that it constituted a new and valid genus, to which the name of *Jateorhiza* was given, on account of the medicinal properties of its root. In 1851, in my "Notes on Menispermaceæ," I gave a very short outline of its leading characters, having two years previously prepared a more ample diagnosis of the genus and the characters of a new species, at the request of Dr. Hooker, which he published in his 'Niger Flora.' The plants of the genus, natives of intertropical Africa, are all climbers, distinguished by a very peculiar habit, having very large deeply lobed leaves, upon very long petioles, and clothed with long strigose hairs; their inflorescence is in long slender racemes; the fruit is a drupe containing a putamen much resembling that of *Odon-tocarya*, and which in like manner is covered with a dense hairy coating imbedded in the fleshy mesoderm. In the structure of its putamen, and the form of its embryo, imbedded in partially ruminated albumen, it quite conforms with the other genera of the *Heterocliniæ*. The bitter and tonic qualities of *Calumba*-root are supposed to be owing to the presence of a peculiar principle allied to cinchonine, and called calumbine, the exact nature of which is not fully ascertained.

JATEORHIZA, nob.—*Flores* dioici. *Masc.* *Sepala* 6, ovata, 2-seriata, exteriora paulo minora, æstivatione imbricata. *Petala* 6, ovata, sepalis paulo breviora, apice truncata, lateribus introflexis stamina tegentia. *Stamina* 6, petalis opposita et subæquilonga; *filamenta* carnosa, apice valde tumida ruguloso-punctata subito refracta, et extrorsum antherifera; *antheræ* globoso-4-lobæ, intus 4-locellatæ, rima horizontali 2-valvatim hiantes. *Ovaria* rudimentaria 3, centralia, punctiformia.—*Fœm.* *Sepala* ut in masc. *Petala* cuneato-obovata, crassius-

cula, apice emarginata, lateribus introflexis stamina volventia. *Stamina* 6, sterilia, petalis dimidio breviora; *filamenta* tenuiora, apice subclavata, glandulis 2 effoetis signata. *Ovaria* 3, libera, erecta, oblonga, gibba, extus dense glanduloso-pilosa, gynæcio sub-3-gono imposita, 1-locularia; *ovulo* unico funiculo brevi ex angulo interno supra medium appenso, *Stylus* brevis, crassus, subexcentricus. *Stigma* 3-partitum. laciniis 2-3-fidis, reflexis. *Drupæ* 3, abortu pauciores, ovatæ, carnosæ, 1-spermæ; *putamen* ovatum, dorso convexum, tuberculatum, pilis fibrillosis creberrime indutum, ventre læve; *condylus* ventralis, scutelliformis, ovalis, extus concavus, intus convexus et paulo intrusus; *semen* loculo conforme, meniscoideum; *embryo* intra *albumen* carnosum quasi 2-laminare fere rectus, lamella exteriore simplici tenui, interiore crassiore in fissuras plurimas transversales profunde ruminata; *integumenta* tenuia, intra plicas albuminis insinuata; *cotyledones* membranaceo-foliaceæ, spathulato-oblongæ, lateraliter divaricatæ, et in locellis distinctis albuminis sepultæ, *radicula* supera brevi tereti ad summum spectante 10-plo longiores.

Suffrutices *Africa tropicæ, alte scandentes, setis rigidis vel pilis setosis vestiti; folia alterna, magna, longe petiolata, cordata, rotundata, palmatim 3-5-7-loba; racemi axillares, elongati, ramis laxis 3-7-floris; flores vagi, pro ordine majusculi, bracteati, subsessiles, bracteis longissime setoso-ciliatis donati.*

1. *Jateorhiza palmata*, nob., Ann. Nat. Hist. ser. 2. vii. 38;—Cocculus palmatus, DC. Syst. i. 522; Hook. Bot. Mag. tab. 2970, 2971;—Menispermium palmatum, Lam. Dict. iv. 99; Calumba, Comm.;—ramis striatis; foliis palmatim 5-7-lobatis, mucronato-apiculatis, sinibus acutis; lobis acuminatis, integris, basalibus profunde auriculatis et approximatis, supra lævigatis, nitidis, subtus pallidioribus, utrinque nervis venisque setis apice glandulosis sparsim hispidis, margine setoso-ciliatis; petiolo crasso, elongato, striato, basi incrassato, fere glabro; racemo ♂ axillari, gracili, petiolo fere 2-plo longiore, setis paucis retrorsis hispidulo, ramis laxis plurifloris; racemo ♀ petiolo dimidio brevior, floribus densioribus, pedicellis 1-floris.—Mozambique (lat. 16° aust.), v. s. ♂ et ♀ in herb. Hook. (Bojer, a Telfairio in insul. Mauritian. cult.). Specim. mag. juv. in herb. Soc. Linn., Wall. Cat. 4953 c.; Mauritius (Telfair).

This species is very distinct from that cultivated in the Calcutta Botanic Garden, the two having been confounded together. The leaves are orbicular, 14 inches diam.; the central lobe from the insertion of the petiole is 10 inches long, the lateral lobes

8½ inches, the lower lobes 8 inches, the basal portions of which are closely approximated and extend 8½ inches below the insertion of the petiole; the petiole is 6½ inches long, and 2 lines diam. The peduncle of the male raceme is 12 inches long, slender, polished, of a reddish chestnut-colour, striated, and furnished with a very few retrorse stiff hairs, which are sometimes glandular at the apex; its branchlets 2 lines apart are bracteate, 6–8 lines long, with nearly sessile flowers; the female raceme is simple, 8 inches long, with a few distant 1-flowered pedicels, 8 lines long.

2. *Jateorhiza Columba*, nob.;—*Cocculus palmatus*, Wall. (non DC.);—*Menispermum Columba*, Roxb. *Fl. Ind.* iii. 807 (non Comm.);—ramulis teretibus, angulato-striatis, breviter retrorsum hispido-pilosis; foliis late orbicularibus, sinuato-lobatis, sinibus rotundatis, lobis 5, late ovatis, acutis, apice mucronato-acuminatis, basalibus profunde divaricatis, et hinc late cordatis, 7–9-nerviis, supra opacis, utrinque pilis brevibus adpressis curvulis rufescentibus munitis, subtus pallidis, nervis venisque valde reticulatis prominentibus, in nervis longius et patenter glanduloso-hispidulis; petiolo subtenui, striato, imo incrassato et tortuoso, patenter glanduloso-hispido; racemis axillaribus, solitariis vel plurimis, ♂ foliis longioribus, imo nudis; rachi valde elongata, striata, patenter strigosa, ramis elongatis, divaricatis, fere capillaribus, glabris, subflexuosis, paucifloris, imo bractea lineari setoso-ciliata donatis; floribus sessilibus, fere ebracteatis.—In Africa Australi, ora orientali inter Mozimba et Ibo (lat. 11° aust.), v. s. in herb. Soc. Linn. (Wall. Cat. 4958), hort. Bot. Calc. cult.

I have nowhere seen native specimens of this species, the male plant of which was introduced, many years ago, from the locality above quoted into the Botanic Garden of Calcutta, where it is still cultivated. A long account of it was published by Dr. Berry, in the 'Asiatic Researches' (x. 385, t. 5). Its native place is 5° to the northward of Mozambique, where the former species is found. Its branches are soft and of very lax texture, of annual growth, seldom exceeding ¾ inch diam.; its leaves are not so membranaceous as those of the former species, and in no degree polished above, the reticulations being finer, more numerous, and more prominent: in the former species the incisures are acute; here they are wide and rounded; and the basal lobes, which in the former are longer, more parallel, and nearly overlapping one another, are here shorter and much divaricated: the petiole is not so densely pilose, and is only half the thickness of that of the former. The inflorescence is very dif-

ferent, the flowers being larger, and the ciliated bracts at the base of the branchlets far more conspicuous. The leaves are smaller and broader in proportion, their total length, including the basal lobes, being $7\frac{1}{4}$ inches, while their breadth is $9\frac{1}{2}$ inches, the central lobe from the insertion of the petiole measuring 6 inches, the lateral lobes $5\frac{1}{4}$ inches, the lower lobes 5 inches, the basal portions of which are wide apart, and extend $1\frac{1}{2}$ inch below the line of insertion of the petiole; the petiole measures $5\frac{1}{2}$ inches, and is 1 line diam. The male raceme is 18 inches long, its rachis being sparsely pilose with spreading glandular reddish hairs; its branchlets are divaricated, filiform, flexuose, glabrous, $1\frac{1}{2}$ inch long, and 7-8-flowered; the flowers are sessile, glabrous, and 3 lines diam. when expanded.

8. *Jateorhiza strigosa*, nob., Hook. Fl. Nig. 212, pl. 18;—*Cocculus macranthus*, Hook. fil. in Hook. Icon. pl. 759;—foliis rotundatis, sinuato-3-lobatis, basi profunde inciso-cordatis; lobis acute 3-angularibus, mucronatis, lateralibus imo in auriculas basales profundas rotundatis, marginibus parallelis fere approximatis, submembranaceis, reticulatis, supra nitidis, subtus pallidioribus, 7-nerviis, nervis utrinque setoso-strigosis, setis adpressis rigidis rufulis longiusculis, margine dense setoso-ciliatis; petiolo striato, auriculis 2-plo longiore, arcte setoso-strigoso; racemo axillari; floribus cæruleo coloratis (Smith), lutescenti-albis (Vogel).—In Africa, ora occidentali, v. s. in herb. Mus. Brit., Congo et ins. Fernando Po (Exped. Tuckey); in herb. Hook. ♂ et ♀, Clarence Cove, Fernando Po (Vogel).

This is a very distinct species. The leaves, including the basal lobes, are $9\frac{1}{2}$ inches long, 9 inches broad; from the apex to the insertion of the petiole is $7\frac{1}{4}$ inches; the lateral lobes, with a broad intervening sinus or undulation, are 6 inches long; the depth of the basal lobes is therefore $2\frac{1}{4}$ inches; the petiole is $5\frac{1}{2}$ inches long. The raceme is 5 inches long, its branchlets 2-3 lines in length; its flowers are much smaller than those of the preceding species, and about the size of those of the first-mentioned typical plant, scarcely exceeding 2 lines diam. when expanded. The above dimensions are from the specimen in the British Museum: in those of Vogel's Collection the leaves are only $3-4\frac{1}{2}$ inches long, 4-6 inches broad, on a petiole 6-8 inches long; the racemes are only 2-4 inches long.

[To be continued.]

XVII.—*Characters of Coilostele, an undescribed Genus of Auriculacea* (?), and of *Species of Helix, Pupa, and Ancyclus, from India, West Africa, and Ceylon.* By W. H. BENSON, Esq.

COILOSTELE, B., nov. gen.

Testa imperforata, elongato-cylindrica; axis columellaris interna spiræ obsoleta. Apertura semiovata; margine columellari superne oblique subspiraliter uniplicata.

Coilostele scalaris, B.

C. testa imperforata, elongato-cylindrica, lævi, hyalina, nitida; spira elongata, gradatim scalariter attenuata, apice obtuso, sutura profunda; anfractibus 6, convexiusculis, superne obtuse angulatis, penultimo cylindræo; apertura subobliqua, semiovata, subpyriformi; peristomate tenui, recto, marginibus remotis, margine columellari crassiusculo, plica spirali obliqua elongata superne intrante munito.

Long. 3, diam. vix 1 mill. Apert. $\frac{2}{3}$, lata $\frac{1}{2}$ mill.

Habitat ad Humeerpore, Bundelkhund, prope ripas fluviorum Jumna et Betwa.

I discovered this shell, in October 1826, in the sand of the Betwa river, while searching for *Achatina Balanus*, of which I had taken a specimen in the aperture of a derelict *Helix*; and after a few days I took dead specimens, with the same minute *Achatina*, among the clay-covered roots of a large tree which had fallen in the peafowl jungle on the left bank of the Jumna opposite to Humeerpore, and in a dried hollow near it, whither those shells had been washed in the rains with *Bulimus gracilis*, Hutton. In January 1839 I took, I believe, a single specimen among the porphyritic and greenstone rocks of the singular crater-like hill of Khaneen, sixteen miles south of Hansi, in the Delhi district, but broke it before I could examine it under a lens.

In a list published in the Calcutta 'Gleanings in Science' of 1829 I set this shell down as a minute *Pupa*; but on observing that the spiral column was obsolete or absorbed, as in the genus *Pythia* (*Scarabus*), I came to the conclusion that the form really belongs to the family of Auriculacea. In the other inland genus, *Carychium*, the spiral column is intact, except close to the summit, although in the littorine genera *Alexia*, *Auricula*, *Melampus*, and *Cassidula* I find the internal structure of the spire similar to that of *Coilostele* and *Pythia*.

In *C. scalaris* the aperture has some resemblance to that of *Jaminia*, Say, a North-American marine operculate genus, which Küster included in the Auriculacea, but which is now referred to the Pyramidellidæ.

Shortly before 1853, Capt. T. Hutton collected specimens of

C. scalaris in the exuviae of the River Ganges, probably in the Do-áb portion of the stream.

With reference to the internal spiral formation of *Pythia*, Pfeiffer observes:—"Testa ut plures Auriculaceorum sectiones ea peculiaritate notabilis est quod septa interiora in anfractibus superioribus desint, observante primo cl. Chemnitzio." Küster also quotes Chemnitz's observations on the same appearance in the genus; but I can trace no record in Pfeiffer respecting the other genera in which it has been observed. In *Alexia* the animal cone runs up the hollow, and has evidently absorbed the portion of the shell which it has displaced.

It is worthy of record that, about the year 1843, Capt. W. J. Boys took specimens of *Achatina Balanus* at the Taj, near Agra, in company with a minute *Carychium*, very similar to the Himalayan species *C. indicum*, B.; subsequently Capt. Hutton found it in the exuviae of the River Ganges; and in 1857, Mr. W. Theobald found the same *Achatina* at Gopnâth, in Kattiwâr. These shells may have a still wider range, being overlooked in consequence of their minute size.

Helix palmaria, B.

H. testa perforata, subconica, spiraliter 7-lirata, striis filosis obliquis confertissimis decussata, sub epidermide cornea albida; spira subconica, apice obtusiusculo lævigato, sutura impressa; anfractibus $6\frac{1}{2}$, convexis, ultimo subtus convexiusculo, peritremate leviter carinato; apertura obliqua, late angulato-lunata, subsecuriformi; peristomate tenui, recto, margine columellari superne breviter expansiusculo.

Diam. major $8\frac{1}{2}$, minor 8, axis 6 mill.

Habitat ad montem Nundydroog in regione Mysoriana.

Two imperfect specimens were found by my son, Capt. C. A. Benson, on the Fort Hill of Nundydroog, north of Bangalore, in Mysore, and a single specimen (fully grown, but weathered) by my daughter, Mrs. R. H. Sankey, at the same place, about 4000 feet above the level of the sea. It is very distinct from the various lirata species described by the Messrs. Blanford in the 'Journal of the Asiatic Society' for 1861, from the hill-ranges of Southern India.

Helix contracta, Hutton, MS.

H. testa late umbilicata, depressa, discoidea, oblique striatula, lævigata, nitidula, albida, fascia rufescente supra angulum superiorem cincta; spira planata, apice vix elevatiore, sutura impressa; anfractibus 4, sensim accrescentibus, convexiusculis, ultimo supra peripheriam compressiusculo subangulato, antice latiore oblique descendente, subtus convexo, umbilicum mediocre, medio anguste excavatum, suturaque brevi profunda munitum

circumstante; apertura valde obliqua, lata, ovato-lunari; peristomate non continuo, superne expansiusculo, subhorizontali, infra reflexiusculo, marginibus conniventibus approximatis.

Diam. major 13, minor 10, alt. 4 mill. Apert. lata $5\frac{1}{2}$, alt. 4 mill. Habitat prope Mhow, Malwa. Detexit Capt. T. Hutton.

This shell approaches *H. Nilagirica*, Pfr., but may at once be distinguished by its narrower umbilicus, showing only one and a half less convex whorls, by its flatter spire, different surface, and less suddenly deflected last whorl, which is subangulate and not rounded at the periphery, also by the non-continuous peristome. It occupies an intermediate place between the southern *H. Nilagirica* and the Bundelkhund *H. asperella*, Pfr., first taken by me in 1824, also taken at Mhow by Capt. Hutton. It is worthy of remark that on the underside of *H. Nilagirica* there is a tendency to granulation like that of *H. asperella*, but that *H. contracta* presents no trace of it*.

Pupa Thibetica, B.

P. testa rimato-subperforata, oblongo-ovata, lævigata, translucēte, vitrea; spira ovata, apice obtuso, sutura impressa; anfractibus 5, subconvexis, ultimo antice ascendente; apertura obovata, 6-plicata, plica 1 parietali angulari, secunda inferiore profunda, dentibus 2 columellaribus duobusque palatalibus profundis munita; peristomate tenui, expansiusculo, margine columellari reflexiusculo. Long. 2, diam. 1 mill.

Habitat ad Iskardo, Thibet. Detexit Dr. Thomson.

This shell, received some years ago through Mr. Woodward of the British Museum, is nearly allied to *P. Huttoniana*, Bens., to which I erroneously referred it originally; but, on close examination, perfect specimens exhibit two parietal plaits, one of which is remotely seated, and in some positions is not easily detected.

Pupa Gutta, B.

P. testa obsolete rimata, oblongo-ovata, lævigata, tenui, pallide cornea, translucēte; spira obtuse ovata, sutura impressa; anfractibus $4\frac{1}{2}$, convexiusculis, ultimo antice vix ascendente; apertura obliqua, edentula, angulato-rotundata; peristomatis marginibus remotis, dextro recto acuto, columellari expansiusculo.

Long. $1\frac{3}{4}$, diam. 1 mill.

Habitat in valle Spiti, Kunawurensi. Detexit W. Theobald.

A single specimen, apparently adult, was received from Mr.

* On referring to Capt. Hutton's description of an unnamed *Carocolla*, in page 520 of the 'Journal of the Asiatic Society of Bengal' for 1834, which was found by him between Nimuch and Mhow, I have come to the conclusion that it is intended for the shell subsequently received from him under the MS. name of *Helix contracta*.

Theobald. *Pupa Himalayana*, Hutton (Annals, Dec. 1863), an elongate and strongly sculptured shell, is the only edentate species previously described from the Himalayan region.

Pupa Eurina, B.

P. testa perforata, ovato-cylindrica, solidiuscula, suboblique striatula, rufo-castanea, nitidula; spira ovato-cylindrica, apice obtuso, sutura impressa, submarginata; anfractibus $7-7\frac{1}{2}$, convexis, ultimo antice ascendente; apertura semiovata, subobliqua, edentula; peristomate expansiusculo, albido, margine dextro extus postice incrassato.

Long. $2\frac{1}{2}$, diam. 1 mill.

Habitat ad Tribeni Ghât fluminis Gogra. Detexit W. Theobald.

This shell closely approaches the edentulate variety of *P. marginata*, Drap. (*muscorum*, L.), in form and aperture. It is much larger than the British specimens of that species, and more solid, and may easily be distinguished by its decided perforation, instead of being merely rimate, and by the margination of the suture. The specimens sent by Mr. Theobald were all derelict, and some are deficient in colour.

Pupa Ofella, B.

P. testa vix rimata, globoso-ovata, confertim striatula, albido-vitrea, translucente, polita; spira subovata, superne convexa, apice obtuso, sutura impressa; anfractibus 4, convexis, ultimo antice non ascendente; apertura vix obliqua, angulato-ovata, 4-dentata, plica parietali mediana curvata duplici subdenticulata intrante, dente columellari marginali magno crasso bicruri palatalibusque 2 marginalibus (superiore infra elongato, inferiore acuto) munita; peristomate incrassato.

Long. $1\frac{1}{2}$, diam. 1 mill.

Habitat prope Liberiam Africæ occidentalis.

This minute shell (long mislaid) has been several years in my possession: it fell out of the interior of one of several shells from Liberia, and appears to have been overlooked by collectors, and not to have been obtained by the describers of species from that part of Africa. The shell is in excellent condition, and its animal had probably crept with it into the aperture of the deserted shell of another species. There is a bright red appearance internally, which leads to the belief that a portion of the animal is scarlet, as in *Ennea bicolor* and several Mauritian *Pupa*.

Ancyclus Ceylanicus, B.

A. testa suboblange conoidea, antice convexa, postice concava, extus tenuissime radiato-costulata, costis subremotis elevatioribus munita, striis confertis concentricis decussata, viridescenti-cornea, margine lato, lutescenti-cornea, apice submediano, subelongato, postice at-

tenuato, acutiusculo, ad dextram leviter verso; apertura subrotundato-ovata, intus albida nitente.

Long. 6, lat. 4, alt. $2\frac{1}{2}$ mill.

Habitat in regione Matelle Ceylanica.

Two specimens were procured by Mr. F. Layard from the Lagalle division of the Matelle district. This is the first species of the genus which has been found in Ceylon. It is related to the European *A. fluviatilis*, but may at once be distinguished by the elevated radiate ribs which occur at short intervals and, equally with the depressed spaces, are marked longitudinally with the minute ribs at their sides.

M. Bourguignat represents *Ancylus Baconii* as occurring in Bengal. *A. Verruca*, Bens. (Annals for January 1855), taken by me at Bhimtál, and by Dr. Bacon and myself in Rohilkbund, and which was found by Mr. Theobald in Orissa, is the sole Indian species decidedly known. I strongly suspect that M. Bourguignat's species is that which was taken by Dr. J. F. Bacon at Henley Park, six miles from the Darling Range, in West Australia.

Cheltenham, Dec. 26, 1863.

Erratum.—In 'Ann. & Mag. Nat. Hist.' for December 1863, p. 427, line 11 from top, for "parietal" read "columellar."

XVIII.—*Notes on some Molluscos Animals from the Seas of China and Japan.* By ARTHUR ADAMS, F.L.S. &c.

"THERE is in shell-fish something more to consider than their shells," observes wise old Adanson; and indeed we are all aware that a knowledge of its testaceous envelope is not always sufficient to determine the natural position or affinities of a mollusk. I lately placed my genus *Scaliola* with the "Wentletraps," and associated my *Diala* with *Planaxis*; *Fenella* also fared no better, and was regarded by me as a Pyramidellid. On becoming acquainted, however, with the animals of those genera, I have been enabled, by means of the 'Annals,' to refer them to their natural families; and as any account of these molluscos creatures, written down from careful observation on the spot, must be of interest, I have thrown together some of my notes for insertion in your Journal. The photographic art may some day be applied to portray the forms of the Mollusca: in the meantime, accurate drawings should not be despised; and I trust at some future period to be able to reproduce a few of mine of the mollusks of Japan.

Photinula quæsitæ, A. Ad.

P. testa orbiculato-conica, imperforata, spira elatiuscula, regione

umbilicali valde impressa, umbilico callo albo oblecto; carneo-rufescenti, ad suturas radiatim castaneo nebulosa, ad peripheriam maculis obliquis albis castaneisque ornata; anfractibus $5\frac{1}{2}$, convexis, transversim liris, liris superioribus moniliformibus, inferioribus simplicibus; anfractu ultimo ad peripheriam rotundato-angulato; apertura subcirculari, intus sulcata et vivide iridescente. Lat. 9 lin., alt. 7 lin.

Hab. Aniwa Bay; 17 fathoms: Tatiyama: Kino-O-Sima.

This is a large and handsome species, with the upper thread-like ridges of the whorls beaded, and the lower ones simple. It is of a reddish flesh-colour, blotched and variegated with pale chestnut at the sutures and periphery.

The animal has a large prominent muzzle, bearded at the end. Head-lobes none. Tentacles prismatic, flat above, beset with short cilia, and lined with red-brown. Eyes on dull black bulbs with small bright black pupils at the end of subtruncate white swellings, supported on thick cylindrical white pedicels. Neck-lappets large, the left white, plain-edged, notched near the eye-pedicel, and involute; the right also white, but festooned and with the margin shortly ciliated. Lateral filaments with short cilia, four on each side, each with a red-brown line down the middle. Mantle-margin finely papillose, and shortly reflexed over the front edge of the shell. Foot milky white, speckled and reticulate with red-brown (the same colour as the markings on the shell), very long, powerful, and thick, acuminate behind, truncate in front, with two little slender tentacular filaments at the angles, prismatic behind the operculum, where it is flat above, with two prominent ridges at the angles; margin of sole shortly ciliated.

The animal often greatly extends the foot, and uses it as a lever to turn over and regain its original position.

Serpulus Adamsi, Mörch.

The animal is pale pearl-white, minutely flecked with opaque white. The tentacles are flattened, short, and somewhat triangular, bearing a minute sessile black eye at their outer bases, just within the commencement of the neck-lobe. The under edge of the tentacles and the neck-lobe are adorned with regular rather distant yellow dots, forming the pupils of as many olivaceous eye-like spots. The head is green, sprinkled with white, and with a vertical groove extending down the middle. The head is very long, gradually growing narrower, and ending behind in a tapering point, and in front in a short and rounded muzzle.

The foot is large, fleshy, hollow at the sides, and spotted near the fore part with olive-green. At the lower edge there is a

sharp prominent keel, articulated with white and dark green. This angular ridge separates the hollow sides from the flat lower portion, which is of a dull pinkish white. The sole, or small anterior membranous portion situated in front of the head, is of a pale white, and the broad circular expanded disk is marbled with olivaceous, the edges being prettily spotted with dark green and white.

A favourite attitude is one in which the position of the animal in its tubular shell is reversed, and the disk of the foot applied against the upper edge, the concave sides forming two hollow channels to conduct the water to the gills, thus performing the office of siphons. This beautiful creature is common along the shores of Manchuria and Japan, where it adheres to the tidal rocks. My examples were obtained from 7 fathoms' water at Mososeki, in the Inland Sea or Seto-Uchi. The same species has recently been described by Dr. Dunker, in his '*Mollusca Japonica*,' as *Serpulorbis imbricatus*.

Pilidium commodum, Midd.

In a sandy bay of Saghaleen, near Cape Notoro, great masses of *Laminaria* were thrown up in heaps on the beach after a tremendous gale; and it was during an examination of the rich stores of shipwrecked and stranded animal remains that I found several specimens of what I believed to be an undescribed shell. Being at the time unacquainted with Middendorff's *Pilidium commodum*, I named my shell *Capulus depressus*, under which name it is published in the '*Annals*' for 1860.

According to Middendorff's description, the animal does not differ from that of *Capulus*; but perhaps the extremely depressed form of the shell may allow *Pilidium* to remain as a subgenus of *Capulus*. In the '*Spitzbergen Mollusca*' of Otto Torrell (p. 88) it is stated that Prof. Lovén has named this shell *Piliscus probus*, altering the name *Pilidium* because Prof. E. Forbes had used it for *Iothia*; though why he should have altered the specific name also is not stated. *Pilidium* of Forbes, however, or *Iothia* is the same as *Lepeta* of Gray; so that *Pilidium* of Middendorff should still be employed for this northern *Capulus*. Hisinger, according to Torrell, described the same shell in his '*Lethæa Suecica*' as *Capulus Hungaricus*; and Torrell himself proposes to call it *Piliscus commodus*.

Eburna japonica, Reeve.

In this species the tentacles are ringed with red-brown, and speckled with light yellow; and the siphon is spotted with yellowish white, and irregularly banded with red-brown lines. The foot (long, large, thick, and fleshy, like that of *Buccinum*) is

transversely banded with irregular red-brown lines and minutely spotted with pale yellow. The sole is also edged with pale yellow. At the caudal extremity of the foot there is a single conspicuous cylindrical terminal filament. I obtained living specimens from 35 fathoms, off Tsu-saki, in Japan.

Cancellaria Spengleriana, Desh.

The latest account of the animal of *Cancellaria* I have seen is given by Dr. Gray in his 'Guide to Mollusca.' It is very vague and imperfect; but the true position, I believe, is there suggested to be in close vicinity to *Mitra*.

In *Cancellaria Spengleriana* the tentacles are broad, flat, triangularly subulate, wide apart, separated by the base of the retractile proboscis. The eyes are small and black, and are placed on slight tubercles at the outer bases of the tentacles. The mantle is furnished with a small siphonal fold. The foot is large, flat, truncate in front, with short side-angles, and acuminate and produced behind. Operculum none.

The tentacles of this species are rendered dark nearly as far as the eyes by close-set small red-brown dots; the siphonal fold of the mantle is sparsely spotted with the same; both dorsum and sole of the foot are reticulate with red-brown lines, and dotted with the same colour.

The animal is very shy, rarely showing more than the tips of the tentacles beyond the front edge of the shell. It has the power of considerably extending the fore part of the foot, using it as an exploring organ.

Turcica instricta, Gould.

I observed the animal of this shell at Satanomo-saki, where I dredged living specimens from a depth of 55 fathoms. It is the *Trochus instrictus* of Gould originally, then a *Monodonta*, afterwards (*Otia Conchologica*, p. 245) a *Euchelus*. It has, however, the tortuous columella and general characters of my genus *Turcica*, founded in 1854 upon a large species from Australian seas. My *Monodonta angulifera*, from the Philippines, is an allied but quite distinct species; and I have recently described a few others. These smaller *Turcica* with the outer lip sulcate have been separated by my brother and myself, in our 'Genera,' as a subgenus of *Euchelus*, under the name of *Perrinia*. It would, however, have been more correct to have placed them under the genus *Turcica*.

In this animal the head, neck, and upper part of the body are finely reticulate with light brown, and the tentacles and siphon are minutely speckled with opaque white. The tentacles are long, white, and semipellucid; the eyes are large and black,

at the tips of short stout pedicels. The head-lobes are small, white, and pectinate. The foot is very small and narrow. Unfortunately, owing to a gale suddenly springing up and capsizing my arrangements, I was unable to note any peculiarities of the neck-lappets and lateral filaments.

Glyphis quadriradiata, Sow.

An examination of the animals of P. P. Carpenter's group of Fissurellids, which he has appropriately named *Glyphis*, on account of their beautiful sculpture, is the more important as they cannot from their shells alone be distinguished from *Lucapina* of Gray, with which, in our 'Genera,' my brother and myself have associated them.

The animal of this species is semiopaque, milk-white. Tentacles moderate; eyes large and black, on prominent tubercles at their outer bases. Muzzle short and rounded. Mantle double-edged, the outer or upper margin simple and plain, and just turned over the edge of the shell, the lower forming an expanded membranous curtain, fissured in front, extending considerably beyond the shell, and overhanging the foot; the margin plain, simple. Sides with a row of short, opaque-white, conical papillæ (nine on each side). Foot ovate, moderate, rather acuminate behind. The species occurs in Japan; but my living animal was dredged from 29 fathoms, stones and shingle, in a tide-race at the extreme point of the Regent's Sword.

XIX.—*Contributions to an Insect Fauna of the Amazon Valley.*

COLEOPTERA : LONGICORNES. By H. W. BATES, Esq.

[Continued from p. 56.]

Genus SERIPHUS, nov. gen.

Body oblong-ovate, convex, setose. [Forehead and muzzle short, as in the *Leiopodinæ* generally. Antennæ elongated, hair-like, setose both above and beneath. Thorax convex; lateral spines tuberculiform, and placed behind the middle. Elytra free from tubercles and ridges, obtusely truncated. Legs moderate; thighs clavate; basal joint of hind tarsi about equal to the two following taken together.

♂ Apical ventral segment obtusely rounded; dorsal sharply truncated, with the angles distinct.

♀ unknown.

The species which constitutes this genus would probably be better placed in a section or subgenus of *Sporetus*. It differs greatly from the *Sporeti* in colour, being of a rich changeable silky-green hue.

Seriphus viridis, n. sp.

S. supra viridi-sericeus, purpureo nitens, nigro setosus: thorace postice macula, elytris plagis tribus cinereo-tomentosis. Long. 3½ lin. ♂.

Head minutely punctured, black; vertex silky green. Antennæ black; base of the third joint and a broad ring on the fourth grey. Thorax shagreened silky green, the middle of the hind margin with a patch of ashy tomentum. Elytra briefly truncated at the tip; surface thickly punctured towards the base, and having besides many rows of setiferous punctures, running from base to apex; silky green, changing with the play of light into dullish purple; a rounded spot of ashy tomentum on the disk of each before the middle, and a similar common spot over the suture near the apex. Legs shining black. Body beneath black, clothed with scant ashy pile.

One example only of this peculiarly-coloured species occurred, namely at Ega, on the Upper Amazons.

Genus *ÆDOPEZA*, Serville.

Leiopus (§ *Ædopeza*), Serville, Ann. Soc. Ent. Fr. iv. p. 88.

This group was distinguished by Serville from *Leiopus* on account of the singular dilatation of the basal joint of the anterior tarsi, and the length of the basal joint of the hind tarsi, which "equals the three following taken together." The enlargement of the anterior tarsi, which is peculiar to the males, seems to be only a specific character, as several other species, agreeing with Serville's *Ædopeza* in shape of thorax and tarsi, style of coloration, and other minor features, do not present this peculiarity. The group seems to be distinguished from *Trypanidius*, to which it is otherwise closely related, by the great narrowness of the prosternum, the depressed mesosternum, and the length of the hind tarsi. The thorax is convex, and widens from the front to the tips of the lateral spines, which are conical and placed a little behind the middle. The elytra are somewhat uneven, with faint carinæ and centro-basal ridges; they are sparsely setose in some species, naked in others. The terminal ventral and dorsal plates in the ♂ are more or less emarginated; and the ovipositor of the ♀ with its sheath is elongated, the ventral plate being truncated, and the dorsal pointed.

1. *Ædopeza pogonocheroides*, Serv.

Leiopus (*Ædopeza*) *Pogonocheroides*, Serv. l. c. p. 88.

This species is sufficiently well known through the description of Serville. It is of a brown colour, tawny in some parts, and marked behind the middle of the elytra with a black angulated

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streak or spot, followed by an ashy club-shaped streak near the suture, which reaches to the apex; the faint dorsal carinæ are speckled with grey and black, and the antennæ and feet are spotted with brown and grey. The males are known by the enlarged basal joint of the fore tarsi. It varies much in the markings of the elytra, the subapical black spot and the apical ashy streak being both subject to become either enlarged in size or diminished so as to be scarcely visible.

The species has a wide range, and the varieties do not appear to be restricted to localities, specimens before me from Panama not differing from others taken on the banks of the Tapajos and the Upper Amazons. It is a common insect on felled trees in new clearings throughout the Amazons region.

2. *Cedopeza leucostigma*, n. sp.

C. oblongo-elongata, fulvo-brunnea, nigro alboque variegata: elytris oblique sinuato-truncatis, ante medium macula suturali alba. Long. 7 lin. ♀.

Head tawny, vertex with two black spots close to the inner margin of the eyes. Antennæ reddish brown, second to fifth joints each with two whitish rings, the remaining joints (except the second) each with one pale ring. Thorax uneven, tawny varied with dusky, and marked with four short and crooked black vittæ. Elytra elongate-oblong, very long compared with the thorax, apex of each briefly sinuate-truncate; surface punctured, some of the punctures in rows, and these latter each covered by a black spot, and emitting a short bristle; the colour is tawny brown; beyond the middle is an undulated blackish fascia, and before the middle, on the suture, is a round white spot; besides which there are a few white specks on the sites of the faint dorsal carinæ, and an irregular thin white fascia near the apex. Body beneath clothed with fine silky iron-grey pile, the sides of the abdomen spotted with tawny ashy. Legs reddish; thighs prettily variegated with grey; tibiæ and tarsi ringed with grey. Ovipositor of the female short.

One example only, taken on a fallen bough in the forest at Ega. It seems to be closely allied to the South-Brasilian *Trypanidius litigiosus* of collections, which is also an *Cedopeza**.

* *Cedopeza litigiosa*. Oblongo-elongata, brunnea, nigro canoque variegata. Caput obscure fulvum, vertice nigro bimaculato. Antennæ brunneæ, articulis basi cinereis, primo cinereo annulato. Thorax supra inæqualis, brunneus, disco nigro quadrimaculatus, lateribus maculis nigris griseo cinctis. Elytra oblonga, postice attenuata, apice oblique truncata; dorso passim irregulariter punctata haud setosa, brunnea, maculis nigris sparsa quarum duabus majoribus pone medium sitis, et strigis canis varia præcipue apud medium et ante apicem. Corpus subtus tomento tenui griseo vestitum, abdominis lateribus fulvo-griseo

Genus *COSMOTOMA* (Dej.), Blanchard.

Blanchard, Histoire des Insectes, ii. p. 155 (1845) (description very imperfect).

Syn. *Belista*, Thoms. Classif. des Cérambycides, p. 16 (1860).

The present group differs from the neighbouring genera by a multitude of characters; but the length and shape of the basal joint of the antennæ, besides many other minor features, leave no doubt that its true position is in the Leiopodine group. The chief peculiarities reside in the ornamentation of the antennæ—a feature that reappears here and there throughout the family of Longicorns, in groups which have otherwise no resemblance—the fourth joint in *Cosmotoma* having a thick brush of hairs attached to its upper surface, and the second and third having thin pencils of hairs at their tips, besides being clothed with a few long hairs, like the remaining joints. The thorax has a thick conical protuberance behind the middle, in the place of the lateral spines, and its surface has two large obtuse tubercles. The elytra are clothed with long hairs instead of setæ, and the centro-basal ridges, which are very thick and large, are also

maculatis. Pedes brunnei, griseo annulati. Maris segmento ventrali apicali semicirculariter emarginato, dorsali profunde inciso; tarsi antice simplices. Long. 7 lin. ♂. Hab. Rio Janeiro. Coll. Bakewell, Bates, &c.

The two following belong also to this genus:—

Edopeza guttigera. Oblonga, convexa, setosa, brunnea, nigro canoque maculata. Caput cinereo-brunneum, vertice nigro quadrimaculato. Antennæ obscure ferruginæ, articulis (duobus basalibus exceptis) basi griseis. Thorax supra subinæqualis, spinis lateralibus magnis acutis; dorso brunneo maculis obscurioribus; lateribus utrinque ante spinam macula nigro velutina cinereo marginata notatis. Elytra oblonga, obtuse truncata; dorso leniter carinata, punctata, setosa, setis e fasciculis setarum breviorum orientibus; brunnea, maculis liturisque nigris varia et guttulis canis (una majore utrinque prope apicem) ornata; lateribus medio griseis nigro punctatis. Corpus subtus griseum, sericeum. Pedes nigricantes, griseo annulati; articulo primo tarsorum posticorum elongato. Maris segmento ultimo abdominali emarginato. Long. 5 lin. ♂. Hab. Mexico. Coll. Pascoe.

Edopeza apicalis. Oblonga, parum convexa, setosa, brunnea, sericea, atro-purpureo variegata. Caput fuliginosum. Antennæ robustæ, obscure ferruginæ. Thorax brunneus, supra vitta latissima dorsali atro-purpurea sericea cinereo guttata; spinis lateralibus canicis. Elytra oblonga, transverse late sinuato-truncata, breviter fulvo setosa, passim punctata, brunnea plaga magna scutellari maculis lateralibus basalibus fasciata pone medium atro-purpureis, apice utrinque macula triangulari laterali nigro velutina. Corpus subtus griseo sericeum. Pedes obscure ferruginei; articulo primo tarsorum posticorum elongato. Maris segmento ultimo abdominali sinuato-truncato. Long. 5 lin. ♂. Hab. Guatemala. Coll. Pascoe.

created with hairs, the rest of the surface being free from inequalities. The terminal abdominal segment is of normal size and obtuse in both sexes, the female not having an exerted ovipositor. The sterna, head, and muzzle are of the same shape and structure as in the majority of the *Leiopodinae*; but the eyes are rather smaller and more pointed beneath than in many of the foregoing genera; they resemble, however, very closely the same organs in the restricted genus *Leiopus*.

1. *Cosmotoma rubella*, n. sp.

C. rufescens: thoracis lateribus obscurioribus: elytris tomento argenteo strigosis, postice nigro fasciatis. Long. $2\frac{1}{2}$ – $3\frac{1}{2}$ lin. (6 exempl.)

Head dull red. Antennæ red, the hairy clothing black. Thorax dull red, the sides behind tinged with dusky, and the under surface black. Elytra dull red, streaked with silvery tomentum; behind the middle is a broad black fascia, followed by a narrow silvery belt, the apex itself being dusky. Body beneath dusky, with patches of grey pile. Legs reddish testaceous.

A common insect on broken branches in the forest at Pará and on the banks of the Tapajos. I have received Cayenne specimens from Paris as *Cosmotoma venustum* of Dejean's Catalogue; but, according to Chevrolat (Journal of Entomology, vol. i. p. 188), the *C. venustum* of Dejean's Catalogue is the species described by M. Thomson as *Beltista adjuncta*, which, from the description given, cannot be the same as our *C. rubella*.

2. *Cosmotoma nigricollis*, n. sp.

C. rufescens: thorace nigro velutino: elytris tomento argenteo strigosis, postice nigro fasciatis. Long. $3\frac{1}{2}$ –4 lin. (5 exempl.)

Head dull black. Antennæ red, the hairy clothing black. Thorax deep velvety black. Elytra dull red, streaked with silvery tomentum; behind the middle is a broad black fascia, followed by a narrow silvery belt, the apex itself being dusky. Body beneath dusky, with patches of grey pile. Legs reddish testaceous.

This form represents *C. rubella* on the Upper Amazons, being as common an insect at Ega as its sister form is at Pará. It is possible that it may be the species described by Thomson as *Beltista adjuncta*; but the following phrase in this author's diagnosis, "prothorax et elytra extremitate nigra, illo versus apicem maculis 2 albis nebulosis," is quite unsuited to our *C. nigricollis*, there being no white spots near the apex of the thorax. The locality of *Beltista adjuncta* is given as San Domingo;

but M. Chevrolat (*l. c.* p. 188) states that this is an error, the species being from Cayenne, and identical with *Cosmotoma venustum* of Dejean's Catalogue.

Genus STENOLIS, nov. gen.

Body elongate, slightly convex, free from setæ. Forehead short. Antennæ elongate, slender, furnished with short setæ. Thorax somewhat narrow; lateral spines existing as minute tubercles at a distance from the hind angles. Elytra smooth, truncated. Thighs clavate; basal joint of the hind tarsi about equal to the two following taken together. Apical abdominal segment in the males (the only sex known) somewhat elongated, rounded, and entire at the tip; the ventral plate with a longish pencil of hairs on each side.

The single species constituting this genus cannot be included in any of the allied genera, on account of its peculiarities in the form of body and shape of the terminal apical segment of the abdomen. In form it agrees pretty well with certain species of *Nyssodrys* (*N. guttula* and allies), but differs from them in the apical segment of its abdomen being entire. With *Lepturges* it has in common the entire apical segment; but the very different shape of the body and thorax forbids its being included in that group. The pencils of hairs at the tip of the abdomen may be only a specific character.

Stenolis undulata, n. sp.

S. elongata, *gracilis*, *cano-grisea*: elytris fascia undulata pone medium et maculis utrinque duabus lateralibus brunneis. Long. $3\frac{1}{2}$ lin. ♂.

Forehead dark brown, inner margins of the eyes grey; vertex grey, with two blackish lines. Antennæ furnished beneath with short setæ, reddish, tips of joints dusky. Thorax gray. Elytra elongate-ovate, apex obliquely subsinuate-truncate, the angles slightly produced: surface even, finely punctured (except towards the apex), hoary grey, with a clear dark-brown zigzag fascia behind the middle, a curved line of the same colour near the scutellum, and two lateral spots—one, large, before the middle, and another, smaller, near the apex. Body beneath and legs clothed with hoary-grey pile.

One example, taken at Ega.

Genus NYSSODRYS, nov. gen.

Body free from setæ, oblong-ovate or elongate. Forehead and muzzle short; eyes ample, their lower lobe subquadrate. Antennæ greatly elongated, sparingly furnished with setæ

Thorax even on the surface; lateral spines short, conical, placed near to or distant from the hind angles. Elytra free from tubercles, centro-basal ridges, and lateral carinæ, rarely having faint dorsal carinæ, truncated at the apex. Legs moderate; thighs clavate; tarsi with the basal joint scarcely longer than the two following taken together.

♂ Apical dorsal plate of the abdomen entire or sinuated at the tip, ventral notched.

♀ Ovipositor elongated beyond apex of elytra; apical dorsal plate pointed or obtuse, ventral truncated or (rarely) faintly notched at the tip.

1. *Nyssodrys sedata*, n. sp.

N. oblongo-ovata, convexiuscula: thoracis spinis lateralibus conicis, acutis, prope angulos posticos sitis: elytris sordide fulvis, punctis plagiisque brunneis, ante medium plaga communi transversa obscure cæruleo-grisea, pone medium fascia obliqua cana: femoribus crassis. Long. $4\frac{1}{2}$ lin. ♂. (3 exempl.)

Head ashy brown. Antennæ dull reddish, with brown pile; tips of joints, from the third, black. Thorax widening from the front to the tips of the lateral spines, which are conical and placed near the hind angles, thence narrowed in an oblique line to the base; surface dark brown, with tawny marks, four small tawny spots being arranged in a quadrangle in the middle. Elytra subovate, convex, apex briefly and obliquely truncated; surface punctured, tawny brown, with a number of small spots and several larger patches dark brown; across the suture before the middle is a transverse bluish-grey patch, and behind the middle on each elytron is a broadish, oblique, hoary-white fascia, beginning on the lateral margin, but not reaching the suture. Body beneath and legs ashy brown; thighs thickly clubbed.

♂ Terminal dorsal plate of the abdomen obtuse; ventral deeply notched.

This was a rather common insect at Ega, on dead boughs in the forest.

2. *Nyssodrys lentiginosa*, n. sp.

N. oblongo-ovata, convexiuscula: thoracis spinis lateralibus conicis, prope angulos posticos sitis: elytris brunneis, disco cæruleo-griseis brunneo maculatis, utrinque plagis irregularibus fulvis plerisque subsuturalibus, una majore laterali: femoribus modice clavatis. Long. $3\frac{3}{4}$ –4 lin. ♀. (3 exempl.)

Head tawny or ashy brown. Antennæ reddish; tips of joints, from the third, black. Thorax widened from the front to the tips of the lateral spines, which are conical and placed obliquely near the hind angles, thence narrowed in an oblique line to the base; surface dark brown, with scant ashy pile, and marked

with four curved tawny spots arranged in a quadrangle on the disk, and embracing in their curves so many dark-brown spots. Elytra subovate, convex; apex briefly and obliquely truncated, outer angle of the truncature slightly produced; surface punctured towards the base, dark brown; disk and suture bluish grey, speckled with brown; parallel to the suture is a row of small tawny patches, and in the middle of the lateral margin a triangular patch of the same hue. Body beneath and legs clothed with fine ashy pile; thighs not very thickly clubbed.

♀ Ovipositor short, projecting very little beyond tips of elytra; dorsal plate plane, and rounded at the tip, ventral truncated.

Found both on the Upper and Lower Amazons, on dead branches*.

3. *Nyssodrys cinerascens*, n. sp.

N. oblongo-ovata, parum convexa, obscure brunnea, cinereo maculata et conspersa: thoracis spinis lateralibus conicis, prope angulos posticos sitis: elytris breviter oblique truncatis, angulis exterioribus productis. Long. 4-4½ lin. ♂ ♀. (6 exempl.)

Head black, with fine ashy pile. Antennæ reddish, tips of joints, from the third, black. Thorax widened from the front to the tips of the lateral spines, which are conical and placed near the hind angles, thence narrowed in a very oblique line to the base; disk dark brown, with several ashy marks, four of which form in the middle two subinterrupted vittæ. Elytra subovate, slightly convex; apex briefly and obliquely truncated, outer angle of the truncature distinctly produced; surface punctured towards the base, dark brown, with patches of ashy-grey on the disk, speckled with dark brown, and with a number of small patches of ashy grey lying parallel to the suture. Body beneath and legs black, clothed with fine ashy pile.

♂ Terminal dorsal plate obtusely sinuated at the tip, ventral rather deeply and semicircularly notched.

♀ Ovipositor projecting one-third of a line beyond the tips of the elytra; dorsal plate tapering to the tip, but rounded, ventral truncated.

Common at Pará.

4. *Nyssodrys corticalis*, n. sp.

N. elliptica, convexa, sordide fulva, brunneo vittata: thoracis spinis lateralibus conicis prope angulos posticos sitis: elytris oblique truncatis, angulis (præcipue suturalibus) obtusis. Long. 4¾ lin. ♀.

* There is an example of this species in Mr. Bakewell's collection, ticketed "South America" (probably from Cayenne), which has the tawny marks very clear; but the four spots on the thorax are nearly straight, and almost form two tawny vittæ.

Head tawny, vertex with three dusky vittæ. Antennæ dull reddish, clothed with tawny-brown pile; tips of joints, from the third, dusky. Thorax widened from the front to the tips of the lateral spines, which are obtusely conical and placed near the hind angles, thence narrowed very obliquely to the base; surface dingy tawny; disk with three dark brown vittæ, the middle one intersected by the pale dorsal line. Elytra convex, narrowed curvilinearly from half the length to the apex, the latter very obliquely truncated; sutural angles of the truncature rounded off, external ones obtuse; surface punctured, except near the apex, tawny, streaked very irregularly with ashy and dark brown, the streaks short, longitudinal, and of unequal thickness, four, thicker than the rest, lying parallel to the suture. Body beneath and legs dingy light brown.

♀ Ovipositor short, scarcely projecting beyond the tips of the elytra; dorsal plate tapering and rounded at the tip.

Forests of the Tapajos. In markings this species much resembles *Leiopus contemptus* (Chevrolat, MS.) from Mexico, which is a *Nyssodrys* allied to *N. corticalis**.

5. *Nyssodrys spreta*, n. sp.

N. oblongo-ovata, parum convexa, sordide fulvo-brunnea, cinereo maculata: thoracis spinis lateralibus conicis, subuncinatis, prope

* *Nyssodrys contempta*. Oblonga, convexiuscula, postice attenuata (♂). Caput cinereo-fulvum, vertice fusco trimaculato. Antennæ rufescentes, tomento cinereo vestitæ, articulis (duobus basalibus exceptis) apice nigris. Thorax usque ad apices spinarum lateralium dilatatus; spinis brevibus, conicis, prope angulos posticos aitis; dorso cinereo, fusco trivittato. Elytra apices versus paulo attenuata, subtransverse sinuato-truncata, passim punctata, utrinque leviter bicostata; sordide fulva griseo canoque varia, utrinque plagis elongatis tribus fuscis notata. Corpus subtus griseo vestitum. Pedes grisei, tibiis apice tarsisque supra nigricantibus. ♂ Segmento dorsali apicali obtuso, ventrali late emarginato. Long. 4½ lin. ♂. Hab. Mexico. Coll. Bates.

The following common South-Brazilian species also belongs to this part of the genus *Nyssodrys*:—

Nyssodrys lignaria. Oblongo-ovata, convexiuscula. Caput cinereum. Antennæ rufescentes, cinereo vestitæ, articulis (2 basalibus exceptis) apice nigris. Thorax breviusculus usque ad apices spinarum lateralium dilatatus, spinis magnis conicis acutis, ab angulis posticis paulo distantibus; dorso fusco-cinereo, medio maculis quatuor vel vittis duabus fulvis. Elytra postice paulo attenuata (♂) vel oblongo-ovata (♀), subtransverse breviter truncata, utrinque leviter bicostata, passim punctata; sordide grisea vel brunnea fulvo fuscoque maculata, utrinque plaga majore cana laterali. Corpus subtus cinereo vestitum. Pedes nigricantes. ♂ Segmento dorsali apicali truncato, ventrali late emarginato. ♀ Stylo brevissimo, segmento dorsali attenuato, apice rotundato, ventrali truncato. Long. 4-4½ lin. ♂ ♀. Hab. Rio Janeiro (D. Squires). Coll. Bakewell., Bates., &c.

angulos posticos sitis: elytris oblique truncatis. Long. $2\frac{1}{2}$ lin. ♂.

Head dingy brown. Antennæ dull reddish, furnished with very short setæ above and beneath. Thorax moderately widened from the front to the tips of the lateral spines, which are acutely conical, placed obliquely, and separated from the base by a sinuated space; surface dull ashy or tawny brown, with paler marks forming two indistinct interrupted central vittæ. Elytra not broader than the thorax, oblong-ovate, apex rather obliquely truncated, angles distinct; surface slightly convex, punctured (except near the apex) partly in rows, dingy tawny or ashy brown, with paler greyish or ashy specks, four of which (larger than the rest) form an interrupted flexuous fascia beyond the middle. Body beneath and legs blackish, clothed with dingy-brown pile. ♂ Terminal ventral segment faintly emarginated at the apex.

One example, Santarem. The species is distinguished from its nearest relatives by its narrower-oblong form and the situation of the space between the spines and the base of the thorax.

6. *Nyssodrys binoculara*, n. sp.

N. parva, subovata, antice et postice attenuata; thoracis spinis laterilibus brevissimis: elytris convexis, valde transverse truncatis, cinereis, fulvo fuscoque punctatis, apud medium utrinque macula magna nigro velutina fulvo cincta. Long. $2\frac{1}{2}$ lin. ♂.

Head dingy tawny. Antennæ red, apices of the joints (from the third) blackish. Thorax convex, widened from the front to the tips of the lateral spines, which are extremely short, thence narrowed obliquely to the base; surface brown, with curved fulvous spots. Elytra convex, narrowed to the apex, broadly and transversely truncated; surface punctured towards the base, grey, with numerous blackish specks; near the middle on each side is a large round velvety-black spot, neatly margined with fulvous, and touching the lateral margin; apex dusky brown, with a central fulvous spot. Body beneath clothed with ashy-yellow pile. Legs reddish.

♂ Terminal abdominal segment narrowed to the tip; both dorsal and ventral plates slightly notched.

Santarem, on dead twigs. There is a closely allied species found near Rio de Janeiro*.

* *Nyssodrys dioptica*. Subelongata, postice sensim attenuata (♀), convexa. Caput flavo-cinereum. Antennæ rufescentes, articulis (duobus basalibus exceptis) apice obscurioribus. Thorax usque ad spinas laterales leniter ampliatus, deinde paulo attenuatus, spinis longis acutis, ante basin sitis; dorso fusco, medio maculis quatuor fulvis. Elytra elongata, postice sensim attenuata, apice oblique truncata, angulo

7. *Nyssodrys grisella*, n. sp.

N. oblonga, parum convexa : thorace griseo, brunneo trivittato, spinis lateralibus brevissimis acutis prope angulos posticos sitis : elytris brunneis, griseo maculatis, apice peroblique sinuato-truncatis. Long. $2\frac{1}{2}$ lin. ♂.

Head tawny grey, vertex with two dark brown spots. Antennæ pitchy red. Thorax slightly widened from the front to the tips of the lateral spines, the spines very small and conical and placed near the hind angles ; surface tawny grey ; disk with three dark brown vittæ. Elytra rather narrow, apex very obliquely sinuate-truncate, surface sparingly punctured, dark brown, with numerous tawny-grey spots and streaks, two, near the base on each side, more elongate than the rest. Body beneath and legs dark brown, clothed with grey pile ; abdomen testaceous red.

♂ Apical ventral segment slightly emarginated.

Ega, on slender branches in the forest.

8. *Nyssodrys fulminans*, n. sp.

N. oblonga, parum convexa ; thorace griseo, nigro bivittato, spinis lateralibus brevissimis, paulo ante basin sitis : elytris nigricantibus fasciis quatuor griseis fortiter undulatis, apice sinuato-truncatis. Long. $3\frac{1}{2}$ lin. ♂ ♀.

Head dusky, with a grey line running from the top of the forehead to the occiput. Antennæ reddish, tips of joints dusky. Thorax scarcely widened from the front to the tips of the spines, which are extremely small and situated a short distance from the hind angles, the space between them and the base being very feebly narrowed ; surface grey, with two broad and clear blackish dorsal vittæ. Scutellum grey. Elytra oblong, sinuate truncate, the outer angles of the truncature produced, feebly convex ; surface scantily punctured, brownish black, with four thin grey zigzag fasciæ, the space between the first and second and between the third and fourth being darker grey ; besides these lines, there is a grey ring on the margin touching the second fascia, and a dentated grey line continuing from the fourth fascia along the suture to the apex. Body beneath and legs dusky, clothed with silvery-grey pile.

♂ Terminal segment with both dorsal and ventral plates distinctly notched.

externo producto, convexa, passim crebre punctata, sordide grisea, fusco fulvoque conspersa, utrinque apud medium macula reniformi nigro velutina fulvo cincta marginem lateralem haud attingente. Corpus subtus obscure griseum. Pedes nigricantes. ♀ Stylo longiusculo, segmento dorsali attenuato, apice obtuso. Long. 3 lin. ♀.
Hab. Rio Janeiro (D. Squires). Coll. Bakewell.

♀ Ovipositor projecting half a line beyond the elytra ; dorsal plate ending in a blunt point.

I took many examples of this elegantly marked species in the forest at Ega.

9. *Nyssodryis bispecularis*, White.

Leiopus bispecularis, White, Cat. Long. Col. Brit. Mus. vol. ii. p. 384.

"*L. fusco-cinereus* ; thorace medio vitta lata nigro-fusca ; elytris singulis macula magna subovata obliqua suturam non attingente pallidoque cincta, apice truncatis : antennis ferrugineis. Ega" (White, l. c.) Long. $2\frac{1}{2}$ – $3\frac{1}{2}$ lin. ♂ ♀.

This pretty species is of oblong shape, slightly convex and depressed a little before the middle of the elytra. The thorax is but little widened from the front, and the lateral spines are scarcely perceptible at the point where the thorax is broadest—namely, a short distance from the hind angles. The apical ventral segment in the ♂ is broadly notched, and the ovipositor of the ♀ projects but little beyond the tips of the elytra.

Common at Ega, on broken boughs and trunks of fallen trees.

10. *Nyssodryis guttula*, n. sp.

N. oblonga, subdepressa, brunnea, cinereo guttata : thoracis spinis lateralibus brevibus conicis, ab angulis posticis distantibus : elytris subtransverse truncatis : antennis albo quadriannulatis. Long. $3\frac{1}{2}$ lin. ♂.

Head tawny, vertex black, with a central tawny line. Antennæ black, base of second, third, fourth, and fifth joints with a whitish ring. Thorax scarcely widened from the front to the tips of the spines, which are obtusely conical and situated at a distance from the hind angles ; ashy tawny ; surface dark brown, with three ashy spots in the middle, and two longer ones near each of the front angles. Elytra oblong, rather depressed, subtransversely and simply truncated, surface dark brown, sprinkled throughout with little spots and patches of a tawny-ashy hue. Body beneath and legs clothed with ashy-tawny pile.

♂ Apical dorsal and ventral plates very slightly emarginated.

Forests of the Tapajos.

11. *Nyssodryis incisa*, n. sp.

N. oblonga, subdepressa, olivaceo-brunnea, cinereo guttata : thoracis spinis lateralibus brevibus, conicis, ab angulis posticis distantibus : elytris sinuato-truncatis : antennis albo annulatis. Long. $3\frac{1}{2}$ lin. ♀.

Head blackish, vertex with a central ashy line. Antennæ black, base of second, third, fourth, and fifth joints with a whitish ring. Thorax scarcely widened from the front to the tips of the spines, which are obtusely conical and situated at a distance from the hind angles ; dingy ashy, sides each with two short

blackish stripes; disk dark olivaceous brown, with three small ashy spots. Elytra oblong, rather depressed, apex sinuate-truncate, with the angles prominent; surface punctured towards the base, dark olivaceous brown, silky, with a number of dingy ashy specks and cross streaks, some of which unite to form a fascia just before the apex, leaving a clear space before and after it of the ground-colour of the elytra. Body beneath and legs clothed with silky-grey pile; base of thighs testaceous.

♀ Ovipositor slender, projecting about half a line beyond the apices of the elytra; dorsal plate tapering, obtusely pointed.

Taken at Ega.

12. *Nyssodrys anceps*, n. sp.

N. oblonga, subdepressa, olivaceo-brunnea: thoracis spinis lateralibus brevibus, conicis, ab angulis posticis paulo distantibus: elytris sinuato-truncatis, obscure cinereo-brunneis, dimidiis basalibus cæruleo-griseis brunneo punctatis, apice fulvo-cinereo plagiatis: antennis albo annulatis. Long. $3\frac{1}{2}$ lin. ♀.

Head dusky, vertex with a pale line. Antennæ rusty red, tips of joints dusky, bases of second to fifth joints pallid. Thorax scarcely widened from the front to the tips of the spines, which are conical and situated at a distance from the hind angles; sides ashy, streaked with dark brown; disk dark brown, with a dingy ashy dorsal line, and a speck of the same colour on each side of it. Elytra oblong, rather depressed, apex sinuate-truncate, with the angles prominent; surface punctured towards the base, dark olivaceous brown, basal half bluish grey, with brown specks and ashy-tawny patches, apex with a larger ashy-tawny patch, indented with dark brown. Body beneath clothed with dingy-ashy pile. Legs ferruginous, apex of tibiæ dusky.

♀ Ovipositor projecting a little beyond the tips of the elytra. Santarem, on dead trees.

13. *Nyssodrys stillata*, n. sp.

N. oblonga, parum convexa, olivaceo-nigra, sericea: thorace supra vittis tribus, elytris guttis numerosis distinctis, cinereis: fœminæ stylo elongato, fistuloso. Long. 4 lin. ♀.

Head olivaceous black, a yellowish-ashy line from the forehead to the occiput. Antennæ slender, nearly three times the length of the body (♀), blackish, base of second to fifth joints pallid. Thorax scarcely widened from the front; spines very short and obtusely conical, space between them and the hind angles indented; surface olive black, with three dorsal and (on each side) one lateral vitta yellowish ashy. Elytra oblong-oval, very slightly convex, apex obliquely sinuate-truncate; surface (except at the apex) punctured, olive-black, sprinkled with smallish yellow-ashy spots, two near the apex transverse and

larger than the rest; apices themselves margined with ashy. Body beneath clothed with yellowish-ashy pile; legs ringed with ashy and black.

♀ Ovipositor greatly elongated and tubular, projecting one and a half line beyond the tips of the elytra; dorsal plate narrowed to the tip and pointed, ventral truncated.

Ega, on trunks of felled trees.

14. *Nyssodrys vitticollis*, n. sp.

N. oblonga, robusta, subconvexa, atro-fusca, sericea: thorace vittis quinque cinereis: elytris cinereo multiguttatis, apice transverse sinuato-truncatis: antennis albo annulatis. Long. $4\frac{1}{2}$ lin. ♂.

Head black; margins of the eyes and a central vitta, from the middle of the forehead to the middle of the vertex, ashy. Antennæ stout, scarcely twice the length of the body (♂), black, base of third joint pallid, bases of fourth, fifth, and six joints with a whitish ring. Thorax slightly widened from the front to the tips of the lateral spines, which are prominent and conical, the space between them and the hind angles being indented; surface blackish brown, with three clear ashy vittæ on the disk and one on each side. Elytra oblong-oval, apex transversely sub-sinuate-truncate, angles prominent; surface punctured, except towards the apex, deep silky brownish black, sprinkled with a large number of ashy spots. Body beneath clothed with yellowish-grey pile. Legs stout, ringed with grey and black.

♂ Apical ventral segment rather deeply and broadly notched. S. Paulo, Upper Amazons.

15. *Nyssodrys caudata*, n. sp.

N. oblongo-elongata, subdepressa, brunnea: elytris utrinque fasciis tribus fortiter angulatis atro-brunneis (prima interrupta) suturam haud attingentibus cinereo cinctis, apice oblique sinuato-truncatis. Long. $3\frac{1}{2}$ – $5\frac{1}{2}$. ♂ ♀.

Head ashy brown. Antennæ rusty red, tips of joints darker. Thorax slightly widened from the front to the tips of the spines, which are short and conical, the space between them and the hind angles being indented or slightly sinuated; surface light brown, sometimes with greyish marks. Elytra elongate, slightly narrowed towards the tips, scarcely convex, apex obliquely sinuate-truncate (less obliquely and angles more prominent in the ♀ than in the ♂); surface with the basal half punctured, light brown, each elytron with three zigzag or irregular transverse spots or fasciæ of a dark-brown hue encircled with ashy; the first of these, near the base, consists, on each elytron, of two (sometimes three or even four) separated spots; the second is a zigzag belt, broad on the margin, but narrow on the disk.

and terminating before reaching the suture; the third is an oblique spot near the apex. The second and third fasciæ vary much in form—both, in some examples, being reduced to spots which do not touch the lateral margin. In well-developed individuals, the space between the second and third fasciæ is of an ashy hue. Body beneath and legs clothed with ashy pile; the legs sometimes reddish.

♂ Apical ventral segment triangularly notched at the apex.

♀ Ovipositor elongated, projecting $1\frac{1}{2}$ line beyond the tips of the elytra; dorsal plate pointed, ventral truncated.

This is an extremely common species in the Amazonian forests, on fallen trees. The varieties do not seem to be confined to particular localities, as I found extreme forms (as to the development of the markings of the elytra) living together at Ega. It is found also at Cayenne, and exists in French collections under the name of *Leipus caudatus*, Lacordaire, MS.

16. *Nyssodrys signifera*, n. sp.

N. oblonga-elongata, parum convexa, brunnea: elytris fasciis duabus plagam magnam cineream includentibus maculaque parva subapicali nigro-brunneis, apice subtransverse truncatis: ♀ segmento ventrali ultimo breviter emarginato. Long. $4\frac{1}{2}$ – $5\frac{1}{2}$ lin. ♂ ♀. (6 exempl.)

Head ashy brown. Antennæ rusty red, tips of joints dusky. Thorax very slightly widened to the tips of the spines, the latter short, but prominent, and placed nearer the middle than the hind angles, the space between them and the base being moderately narrowed; surface silky brown. Elytra oblong, apex scarcely obliquely truncated in the ♀, more obliquely in the ♂; surface thickly punctured, except over the apical third (which is very smooth), light brown, with two dark-brown fasciæ on each elytron, the basal one oblique, the second angulated at the middle, neither touching the suture, the space between them being of a light ashy colour; near the apex is a small rounded dark-brown spot; the disk on the apical portion is tinged with ashy; the sides are silky brown. Body beneath and legs clothed with tawny-ashy pile.

♂ Apical ventral segment broadly emarginated.

♀ Ovipositor projecting $1\frac{1}{2}$ line beyond the tips of the elytra; dorsal plate obtusely pointed, ventral briefly emarginated at the apex.

This elegant species is found throughout the Amazons region, from Pará to Ega. I have seen it, in Parisian collections, under the name *Leipus hieroglyphicus* (Buquet), Dej. Cat.; but as the following species also exists in the same collections under this name, and no diagnosis has been published to guide us in de-

ending to which of the two it should be applied, I am obliged to pass it over without further notice.

17. *Nyssodrys propinqua*, n. sp.

N. oblonga, subdepressa, brunnea: elytris fasciis duabus obscurioribus plagam magnam cineream includentibus maculaque parva subapicali, apice oblique sinuato-truncatis, angulis prominentibus: ♀ segmento ventrali ultimo integro, truncato. Long. 3-4 lin. ♂ ♀. (7 exempl.)

Head ashy brown. Antennæ rusty red, tips of joints dusky. Thorax widened from the front to the tips of the spines, which are short and conical, and placed nearer the middle than the hind angles of the thorax, the space between them and the base being moderately narrowed; surface silky brown. Elytra oblong, apex obliquely and rather strongly sinuate-truncate in both sexes, angles prominent; surface thickly punctured over the basal half, dingy brown, with two dentated fasciæ of a darker shade on each elytron,—the basal one anteriorly blending with the ground-colour of the wing-case, the second more distinct and very broad on the lateral margin, neither touching the suture, the space between them being of a light ashy colour; near the apex is a small rounded dark-brown spot, encircled with ashy, which in many examples extends laterally towards the margin. Body beneath and legs clothed with tawny-ashy pile.

♂ Apical ventral segment broadly emarginated.

♀ Ovipositor rather short, extending only $\frac{3}{4}$ of a line beyond the tips of the elytra; dorsal plate acute, ventral truncated and entire at the tip.

The present species is almost identical in markings with the preceding, but it differs by its much smaller size, dingier colours, more sinuated truncature of the elytra, and by the apical ventral segment of the female being entire instead of notched at the apex. It is a generally distributed species in the Amazon region, but occurs much more commonly than *N. signifera*. Specimens from Cayenne, under the name of *Leiopus hieroglyphicus*, have been sent to me from Paris.

18. *Nyssodrys simulata*, n. sp.

N. oblonga, subdepressa, brunnea: elytris utraque plaga canescente fusco maculata ante medium, macula dentata laterali alteraque parva subapicali fuscis, apice subtransverse sinuato-truncatis. Long. $4\frac{1}{2}$ lin. ♂ ♀.

Head ashy brown. Antennæ rusty red, tips of joints dusky. Thorax widened from the front to the tips of the spines, which are short and conical and placed nearer the middle than the hind angles; surface light brown. Elytra oblong, apex in both

sexes scarcely obliquely sinuate-truncate; surface faintly punctured towards the base, light brown, each elytron before the middle with a large hoary-white patch sprinkled with clear dark-brown spots, not corresponding with the punctures; behind this white patch there is the usual angulated silky-brown lateral spot, besides a subapical smaller spot on the disk. Body beneath and legs clothed with lightish-brown pile.

♂ Apical dorsal plate feebly, ventral deeply notched.

♀ Ovipositor projecting very little beyond the tips of the elytra; dorsal plate obtusely pointed, ventral truncated.

Ega, Upper Amazons. It has also been found in the interior of French Guiana by M. Bar. The species is readily distinguishable from the two preceding by the white patch of the elytra being sprinkled with distinct dark-brown spots.

19. *Nyssodrys efflicta*, n. sp.

N. oblonga, parum convexa, brunnea: elytris utrinque plaga angulata pone basin guttulisque numerosis griseis, apice oblique sinuato-truncatis. Long. $4\frac{1}{2}$ lin. ♂ ♀.

Head ashy brown. Antennæ rusty red, tips of joints dusky. Thorax widened slightly from the front to the tips of the lateral spines, which are small and acutely conical and placed about as near the middle as the hind angles; surface light brown, with paler specks. Scutellum dark brown, with a central line ashy. Elytra oblong, apex in both sexes obliquely sinuate-truncate; surface thickly punctured near the base, light brown, each with an angulated greyish patch on the side before the middle, and sprinkled with short greyish streaks or spots. Body beneath and legs clothed with lightish-brown pile.

♂ Apical dorsal plate broadly emarginated, ventral deeply notched.

♀ Ovipositor projecting a line and a half beyond the tips of the elytra; dorsal plate pointed, ventral slightly notched.

A common insect on branches of fallen trees in the forest, both on the Upper and Lower Amazons, and at Pará.

20. *Nyssodrys deleta*, n. sp.

N. oblonga, parum convexa, brunnea, sericea; scutello, plaga laterali elytrorum sæpe obsoleta maculaque subapicali cinereis: elytris apice peroblique sinuato-truncatis, angulis externis fortiter productis. Long. 3-5 lin. ♂ ♀.

Head ashy brown. Antennæ rusty red, tips of joints darker. Thorax slightly widened from the front to the tips of the lateral spines, which are small and acute and placed near to the hind angles, the space between them and the base scarcely narrowed; surface light brown. Scutellum ashy. Elytra elongate-oblong,

very obliquely sinuate-truncate, external angles of the truncature strongly produced, almost mucronate; surface punctured near the base, light brown, each with a large faint ashy patch on the side before the middle, margined and spotted with dark brown, and an ashy crescent near the apex enclosing a brown dot; the patch obsolete in many examples, and the apical half of the elytron having sometimes three or four ashy specks. Body beneath and legs clothed with dingy brown pile.

♂ Apical dorsal plate broadly emarginated, ventral sharply notched.

♀ Ovipositor projecting the length of a line beyond the tips of the elytra; dorsal plate pointed, ventral truncated.

This is an equally common species with *N. caudata*, being found at all stations throughout the Amazons region, on dead branches. I have seen it in some collections under the name of *Leiopus deletus*.

21. *Nyssodrys rodens*, n. sp.

N. oblonga, subdepressa, postice sensim attenuata (♂ ♀), nigro-brunnea: thorace vittis quatuor vel sex, elytris lineolis confluentibus suturaque cinereo-brunneis; his apice oblique sinuato-truncatis, angulis exterioribus valde productis. Long. $3\frac{1}{2}$ – $4\frac{1}{2}$ lin. ♂ ♀.

Head light brown, occiput blackish. Antennæ rusty red, tips of joints dusky. Thorax widened curvilinearly to the tips of the spines, which are short and acute, and placed nearer the middle than the hind angles; surface blackish brown, with four (sometimes six) light-brown vittæ (the alternate ones sometimes grey), besides a thin dorsal line, which is often absent. Scutellum light brown. Elytra gradually narrowed from base to apex, the latter obliquely sinuate-truncate, outer angles of the truncature strongly produced, almost spiniform; surface blackish brown, varied with several light-brown (partially grey) streaks of unequal length and very irregular in position, but always with an angulated one near the apex; suture greyish. Body beneath and legs clothed with light-brown pile.

♂ Apical dorsal and ventral segments both notched.

♀ Ovipositor short, projecting to the length of scarcely half a line beyond the tips of the elytra; dorsal plate narrow and pointed.

Found throughout the Amazons region, on slender branches and twigs; beaten once out of a mango-tree.

22. *Nyssodrys lineolata*, n. sp.

N. oblonga, robusta, subdepressa, nigro-brunnea: thorace vittis septem plus minusve indistinctis, elytris fasciis duabus lineolarum maculisque subapicalibus cinereo-brunneis; his apice sinuato-

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truncatis, angulis exterioribus modice productis. Long. $4\frac{1}{2}$ – $5\frac{1}{2}$ lin. ♂ ♀.

Head ashy brown. Antennæ rusty red, spotless. Thorax widened from the front to the tips of the spines, which are conical and placed a short distance from the hind angles; surface dark brown, with seven more or less incomplete light-brown or ashy vittæ. Scutellum ashy. Elytra tapering from base to apex (♂), or more oblong-ovate (♀), apex obliquely sinuate-truncate, outer angles produced; surface shining dark brown, with two broad fasciæ (interrupted at the suture) composed of a number of short ashy longitudinal lines; a few specks near the base and apex and a short line along the outer point of the apex also of an ashy colour. Body beneath and legs clothed with ashy-brown pile.

♂ Apical dorsal plate scarcely emarginated, ventral notched.

♀ Ovipositor very short and broad; dorsal plate broad and obtuse at the tip.

Eggs; rare.

23. *Nyssodrys promeces*, n. sp.

N. angustata, parum convexa, nigro-brunnea: thorace elytrisqve vittis tribus fulvis, his oblique truncatis, angulis suturalibus obtusis. Long. $3\frac{1}{2}$ lin. ♂.

Head ashy brown. Antennæ four times the length of the body, scantily furnished with short setæ, black. Thorax scarcely widened to the tips of the spines, which are conical and placed nearer the middle than the hind angles; surface blackish brown, with three tawny vittæ. Elytra elongate, narrow, obliquely and obtusely truncated at the apex; surface punctured, except near the apex, blackish brown; each elytron with three tawny vittæ terminating before reaching the apex, the sutural and central ones having a shorter faint grey streak between them; the apical part has two angular fulvous spots. Body beneath and legs clothed with silky grey pile; sides of sternum and abdomen with a fulvous line.

♂ Apical dorsal plate truncated, ventral broadly notched.

This curious species approximates in length of antennæ, shape, and colours to the Hippopsine group of Lamiaires; but all its essential features show that it is a true Acanthocinitæ of the Leiopodine section, the basal joint of the antennæ having a waved outline beneath, the thorax and head having the shape usual in the Leiopodinæ, and the sternums the same outline. Its habits are those of a *Hippopsis*, clinging, like the species of this and the neighbouring genera, to slender dead twigs; consequently the claw-joints of the tarsi (especially of the middle legs) are longer than is usual in the Acanthocinitæ, and have some analogy to those of the subtribe Oncideritæ to which the

Hippopsinæ belong; but the claws are not thickened and sub-parallel, and the claw-joints of the fore tarai not elongated—characters which further distinguish the present species from the Hippopsinæ. I do not think the slight elongation of the middle and posterior claw-joints warrants the establishment of a new genus for this species.

24. *Nyssodrys ptericopta*, n. sp.

N. elongata, postice sensim attenuata, fuliginosa, griseo obscure lineata: elytris pone medium cinereo biguttatis, apice oblique valde truncatis. Long. $3\frac{3}{4}$ lin. ♂.

Head tawny yellow, forehead with two brown spots. Antennæ rusty red, basal joint darker. Thorax widened from the front to the tips of the short conical spines, thence narrowed in a sinuated line to the base; surface sooty brown, with seven very indistinct greyish lines. Elytra narrowed from base to apex, the latter obliquely and broadly truncated, angles obtuse; surface punctured towards the base, sooty brown, with several very indistinct greyish lines, and on the disk of each elytron a rounded ashy spot a little after the middle. Body beneath and legs clothed with greyish pile.

♂ Dorsal and ventral apical plates equally notched.
Banks of the Tapajos.

25. *Nyssodrys ramea*, n. sp.

N. oblonga, convexiuscula, grisea, fusco plagiata: thoracis spinis lateralibus tuberculiformibus, mox pone medium sitis: elytris apice truncatis, angulis distinctis. Long. $4\frac{1}{2}$ – $5\frac{1}{2}$ lin. ♂.

Head dingy brown, vertex grey. Antennæ dusky; bases of fourth to seventh joints pale. Thorax widened from the front to the tips of the lateral spines, which are short and conical and placed soon after the middle; surface greyish, with confluent blackish patches. Elytra scarcely obliquely truncated at the apex, angles distinct; basal portion covered with large punctures; surface greyish, with blackish-brown spots and patches, some of them confluent and forming near the middle a zigzag fascia interrupted at the suture. Body beneath and legs clothed with grey pile.

♂ Apical dorsal segment faintly, ventral broadly emarginated.
Eggs, rare. It has been since found also in the interior of French Guiana by M. Bar.

26. *Nyssodrys excelsa*, n. sp.

N. oblonga, subconvexa, brunnea, sericea: thoracis spinis lateralibus ab angulis posticis distantibus; elytris griseis, macula magna com-

muni basali alteraque laterali utrinque pone medium brunneis, apice oblique truncatis, angulis distinctis. Long. $5\frac{1}{2}$ lin. ♀.

Head ashy brown. Antennæ clothed with ashy-brown pile, apices of the joints darker. Thorax widened from the front to the tips of the lateral spines, which are conical and distinct and placed nearer the middle than the hind angles. Elytra obliquely truncated at the apex, angles distinct; surface, except near the apex, covered with large punctures, greyish; a large patch in the middle of the base and an oblique lateral spot or belt on each side behind the middle light brown; the apical part has also a faint brownish cloud. Body beneath and legs clothed with greyish pile.

♀ Ovipositor projecting to the length of a line beyond the tips of the elytra; dorsal plate narrow, pointed, ventral truncated.

Ega, rare.

27. *Nyssodrys alboplagiata*, White.

Leiopus alboplagiatus, White, Cat. Long. Coll. Brit. Mus. ii. p. 381.

"*L. pallide fulvo-ochraceus*, sericeus: elytris plaga magna laterali alba, elytris punctatis: metathoracis lateribus albis. Ega." Long. $6\frac{1}{2}$ lin. ♂ ♀.

This fine species is similar in shape to the two preceding, the lateral spines of the thorax being conical, short, and nearer the middle than the hind angles. The elytra are rather obliquely truncated, with both angles slightly prominent.

♂ Both dorsal and ventral plates of the terminal segment notched.

♂ Ovipositor projecting to the length of nearly two lines from the tips of the elytra.

Ega, closely adhering to slender branches of dead trees.

[To be continued.]

BIBLIOGRAPHICAL NOTICE.

A Manual Flora of Madeira. By R. T. LOWE, M.A.
Part 3. London: Van Voorst, 1864.

WE are glad to receive another Part of Mr. Lowe's valuable book: it extends from page 263 to 377, and completes the description of the *Calycifloræ*, which was commenced in Part 2. That portion of the work was published just two years since, and Part 1 four years and a half previously. How long, alas! may we have to wait for the completion of a book of the utmost importance to botanists who are interested in what is sometimes called the Atlantic Flora! It is probably known that weak health caused Mr. Lowe to establish himself at Madeira many years since, and that this book is the result of

at least six-and-twenty years of study of the vegetation of the island. The necessity even now of being absent from England during the early part of each year is one cause of the small progress made with his Flora; but another is the great care and caution exercised in the preparation of every part of it.

This instalment is of less interest to the English botanist than its predecessors. It treats chiefly of plants belonging to a southern type—*Myrtaceæ*, *Cucurbitaceæ*, *Mesembrianthemaceæ*, *Cactaceæ*; and even when the orders are those of plants which inhabit Western Europe, the species are usually different. This was not so much the case in the former, and apparently will be less so in future Parts. The elaborate account of the *Cucurbitaceæ* will be read with much interest and advantage; the account of the *Cacti* also is valuable. But it is impossible to open the book without seeing proofs of the accuracy and care of its author.

There are not many new species introduced; for most of those found by Mr. Lowe were already described in his 'Primitiæ et Novitiæ'; but in several instances he now furnishes valuable additional information concerning them: as an example, let the reader turn to the revised and amplified account of the magnificent *Monizia edulis* (pp. 365, 366).

Happily in this case we can dispense with the recognized privilege of reviewers, and make only one complaint,—viz. against the very slow rate of publication. We fear that this delay in the issue of the Parts is unavoidable; for Mr. Lowe has now again started for a southern climate.

We sincerely hope that our recommendation of this book will lead an extensive sale. No student of the botany of South-western, or even Western, Europe ought to be without it.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

May 26th, 1863.—Dr. J. E. Gray, F.R.S., in the Chair.

ON THE SPECIES OF THE GENUS *STERNOTHÆRUS*, WITH SOME OBSERVATIONS ON *KINIXYS*. BY DR. J. E. GRAY, F.R.S., ETC.

The shell or thorax of the *Sternothæri* offer such different appearances, according to the age or other special conditions under which they have lived, that it is almost impossible to distinguish them; and the more specimens are received, the greater becomes the difficulty. Under these circumstances, as the heads seem to present some characters which, as far as I have been able to observe them in the limited number of specimens which come under my examination, seem permanent, I have attempted to define the peculiarities presented by the heads of the specimens in the Museum Collection from different localities. The species were so difficult to distinguish by means of the shell only, that, in my 'Catalogue of

Shield Reptiles in the British Museum,' I stated that all the species there noticed "perhaps may prove only to be varieties of the same species, or dependent on age" (p. 52).

A larger series of specimens from the same locality has shown that such characters as the shape and thickness of the shields, and especially of the first vertebral shield, which have been hitherto to some extent depended on for the separation of the species, are very variable. Therefore the discovery of some other more permanent characters seems important; and the form and disposition of the shields on the head appear to furnish such characters.

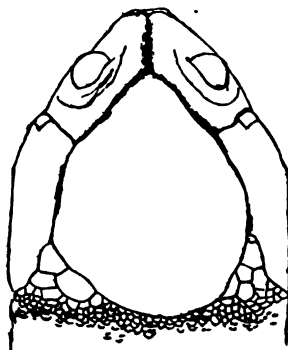
Mr. Cope observes that *S. Derbianus* differs from *S. sinuatus* of Smith "mainly in the form of the upper mandible, which is obtusely hooked in the former, bidentate in the latter." I suspect he must have been misled in these observations by figures or descriptions; for the jaws of the typical specimens of the two species are very similar.

It will be necessary to separate the genus into three sections, according to the form of the head, premising that I only know the species belonging to the third section from the descriptions of MM. Duméril and Bibron, as all the specimens that have come under my observation belong to the first or second section. These sections may be thus characterized :—

1. *Head short and broad; the upper jaw obscurely notched and bidentate in front; the crown shielded to a line even with the back of the tympanum.* Tanoa.

1. *STERNOTHÆRUS SINUATUS*, A. Smith, S. African Zool. t.

Head rather broad, depressed; jaws pale; the temporal plate



Head of *S. sinuatus*.

broad and short, only reaching to the front of the tympanum, and with another rather smaller similar plate behind it over the ear; the hinder vertebral plate of the adult as wide as long, not tubercular; the fore legs with small scales, and with some very wide, slender, band-like shields on the inner side of the upper surface; the sternum with a narrow deep notch behind.

Sternothærus castaneus, part.; Gray, Cat. Shield Rept. B.M. p. 52.

Hab. S. Africa: Natal (*Dr. Krauss*).

In other specimens the front marginal shields are rather wide, the middle one as long as broad; the front vertebral shield is elongate, with straight sides.

I think it better to retain the name given by Dr. Andrew Smith to the Natal specimen for this species; for it is very doubtful to which of the specimens the *Emys castanea* of Schweigger is referable, and one of the specimens I described as *S. castaneus* is certainly *S. Derbianus*.

2. STERNOTHERUS DERBIANUS.

Pentonyx gaboonensis, A. Duméril, Arch. du Mus. x. p. 164, t. 23. f. 2 (young).

The head very broad, depressed; jaw dark, black-lined; the temporal plate single, broad and long, reaching to the back of the tympanum; the upper surface of the front leg with moderate-sized scales, and with many larger, convex band scales on the inner side; the hinder edge of the fourth and the upper edge of the fifth vertebral plate tubercular; the sternum with a deep rounded notch behind; the vertebral plate of the adult longer than broad.

Hab. W. Africa: Gaboon; Sierra Leone.

Our specimens offer several varieties, thus:—

1. Front marginal plates thick, convex, broader than long; the front vertebral shield elongate urn-shaped.

2. Front marginal plates as long as broad, flat; the front vertebral shield elongate urn-shaped.

3. Front marginal plates as long as broad, flat; the front vertebral shields elongate, with straight sides.

In one specimen of the first variety the vertebral shields are much narrower than in the other.

The shield on the crown of the head in the two specimens which have heads is more or less perfectly divided into three shields, viz. one frontal and two occipital, but together they cover the whole top of the head to a line with the back of the ears, and there are only a few small shields between the hinder side of the hinder part of it and the back edge of the temporal shields.

I think there can be very little doubt that the specimen which M. Aubrey Lecomte sent to the Paris Museum from the Gaboon, and which M. Auguste Duméril, in his very hasty and very incomplete and inaccurate paper "On the Reptiles of Western Africa," in the 'Archives du Muséum' (vol. x. p. 165), has described and figured under the name of *Pentonyx gaboonensis*, is only the young state of this species. One is surprised that a herpetologist who must have unrivalled opportunities of study should not have been led by the breadth of the lobes of the sternum to doubt its being a *Pentonyx*. However, it is well, as it gives their museum a representative of a species which they did not formerly possess. But, what is more extraordinary still, M. A. Duméril, who is so ready with and so bitter in his observations on the works of others, though his figure shows that the horny plates consist almost entirely of the areolæ of the large shields, with only two or three rings of deposit round

them, showing that the animal could not long have been hatched, yet observes, "L'aspect de la carapace et sa solidité comparée à celle de la boîte osseuse de jeunes *Pentonyx* du Cap semblent prouver que notre individu est adulte" (p. 164). The example figured must be that on which this observation is founded; for he remarks, "Il est unique dans la collection."

It is probable that *Emys Adansonii* of Schweigger, the *Pentonyx*, and more lately the *Sternotherus Adansonii* of Duméril and Bibron, described from a shell in the Paris Museum said to come from the Cape de Verd, is only a half-grown specimen of this species, which is the only *Sternotherus* I have seen from Western Africa.

The specimen in the British Museum from Sierra Leone, which is described in the 'Catalogue of Shield Reptiles' (p. 52) as *Sternotherus castaneus*, appears to belong to this species.

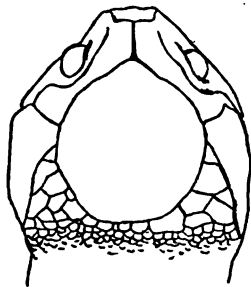
- II. The head rather short and broad; the upper jaw truncated; the crown covered with an oblong shield (or three smaller shields), with a number of smaller shields over the tympanum, between the hinder outer edge of the crown-plate and the upper edge of the large temporal shields. Noton.

STERNOTHERUS SUBNIGER.

S. castaneus, Dum. et Bibr. Erp. Gén. ii. p. 401, t. 20. f. 1.

Head depressed; jaws pale; the upper surface of the fore legs with small scales, and a few rather larger ones on the inner sides.

Hab. Madagascar.



Head of *S. subniger*.

The specimen in the British Museum, which was received from Paris under the above name, and as coming from Madagascar, agrees well with Duméril and Bibron's description and figure; but they do not describe the small shields on the head, and especially say that the frontal plate is much developed, and that there are no occipital plates. Now, in our specimen the sutures of the occipital plates are well seen, and they are peculiar for being oblong and obliquely placed (so as to leave the sides of the occiput to be covered with small shields), instead of being large and trigonal (as they are in the two other species) and covering all the space on the head to the margin of the temporal shields.

- III. "Head elongate; upper jaw with a recurved crown, with a moderate beak; frontal, two long nasal, and two large parietal plates." Anotæ.

STERNOTHÆRUS NIGER, Dum. et Bibr. Erp. Gén. ii. p. 597 (not t. 20. f. 1, as quoted).

Hab. Madagascar.

We have recently received from Western Africa several specimens of the genus *Kinixys*, and they all tend to prove the distinctness of the three species in the 'Catalogue of Shield Reptiles in the British Museum,' viz. 1. *K. Belliana*; 2. *K. erosa*; and 3. *K. Homeana*. *K. Belliana* is easily separated from *K. erosa* (as well as by other characters) by the small size of the gular plates. It would appear that this species is common both to West and Eastern Africa, as Mr. Whitfield brought it from the Gambia, Dr. Peters found it in Mozambique, and Dr. Rüppell at Shoa: so also is *K. Homeana*; for Lieut. Friend found it at Cape Coast in West Africa, and Mr. Berthold on the east coast of Africa.

The *K. erosa* seems to be common in several parts of West Africa. It is abundant at the Gaboon, and seemingly not uncommon at the Gambia. It is a very variable species, but always to be distinguished by the reflexed and strongly dentated posterior margin, and the large size of the gular plates. It varies in form. Some specimens are oblong-elongate, narrow, as wide before as behind (that is to say, straight on the sides): these, as the older specimens have the sternum concave, which we generally consider the peculiarity of the male sex, are probably male. Others are ovate, much broader compared with their length, and broader behind than before, and the sides of the back are more convex: these are probably the shells of females. The specimens of both these shapes are varied with yellow on the upper side of the costal plates, and have short irregular yellow rays at the outer angle of the costal and vertebral shields; but the distinctness of these coloured rays varies in the different specimens. The form of the gular plates also varies; they are always rather large, and the front outer angles are rather produced forward, leaving a deep angular notch; but in one specimen, which has a concave sternum, and is probably an old male, they are very much enlarged, and produced beyond the upper edge of the thorax. They are longer than broad, and truncated in front, so as to present a straight margin without any notch, they are as long as the humeral plate at the inner side, and the front margin of them is as broad as the length of the outer side, which is concavely curved out. There seems, from M. Auguste Duméril's figure, to be only a thorax, without any sternum, of this species in the Paris Museum.

The most natural division of this genus is the following:—

- A. The front lobe of the sternum narrowed and tapering in front, with a small truncated pair of gular shields; the sides of the margin even; nuchal shield distinct. *Kinothorax*.

KINIXYS BELLIANA.

B. The front lobe of the sternum broad ; side curved outwards, with a large pair of gular shields produced at the outer angles ; the sides and the margin strongly dentated. *Kinixys*.

1. *KINIXYS EROSA*. The fifth vertebral plate rounded ; nuchal none.

2. *KINIXYS HOMEANA*. The fifth vertebral plate produced, angular ; nuchal plate distinct.

ON THE ARRANGEMENT OF THE CETACEANS.

BY DR. JOHN EDWARD GRAY, F.R.S., ETC.

In the part of the 'Zoology of the Erebus and Terror' devoted to the Cetacea I collected together all the materials within my reach, and published an arrangement of the genera, and notes on all the species, of these animals which were then known to me, either from the examination of the specimens in different museums, or from the descriptions and observations in various zoological and whaling works. The first part of the 'Catalogue of the Specimens of Mammalia in the Collection of the British Museum,' which is devoted to the Cetacea (published in 1850), may be considered as a revision of the former essay, with the additional material that I had been able to collect since it had been penned. During the thirteen years that have elapsed since the publication of the Catalogue, I have not allowed any opportunity to escape of examining and comparing the different specimens which have come under my observation, and I have read with care all the papers and works that I have been able to meet with bearing in any way on Whales and their allies. I am now induced to lay the results, as far as the general arrangement of the order is concerned, before the Society.

Some zoologists pay little regard to such re-arrangements of genera and the division of them into groups ; but this arises from the points of view from which they regard them. If they look on them as only artificial keys to discover the name of a genus, and thus arrive at the name of a species, and if that is the object of the person who forms them, then they are perhaps estimated at their right value. But I have laboured at these and other arrangements which I have suggested with a very different view. If it is considered desirable to place the species in natural groups called genera, it is certainly equally desirable that the genera so formed should be disposed in the larger and larger groups in such an order as appears to the writer most distinctly to exhibit the natural relations which the genera bear to each other. If they are so disposed, then the name that is given to a group of species is of little importance, as to whether the group is called a genus or subgenus, a genus or subfamily, or a family. They may be so regarded at the caprice or theory of the student, as, whatever may be their nominal value, they are intended to represent a natural group of species, arranged together so as best to represent, according to the writer's view, the natural relation of the species to each other.

If the arrangement of the species into genera requires mature deliberation and the study of the value of the different characters observed as to their permanence and variability in each group (and the variations in different organs are often of very different value in this respect in very nearly allied groups), then the arrangement of the minor groups into larger and larger ones, according to my experience, and indeed as any one may *à priori* suppose, demands a greater power of comparison and reasoning, since there are a greater number of facts, of characters, and of resemblances or differences, and of variation or permanence, to be considered and reasoned on—that is to say, if the constituents of the larger groups are conscientiously examined and determined on, as they must be to render them of value for the purposes above stated.

I am aware that this is not the feeling of many zoologists, but I believe this arises from most zoologists restraining themselves to the study of a limited number of species or genera. This is proved by the fact that many zoologists pay great attention as to who was the first person who gave the name to a genus, though the genus may have been restricted, or even extended, and its characters completely altered since the name was first applied, but pay little or no attention to the first person who formed a group, or to the synonymy or history of the changes which have taken place in the characters or arrangement of the group or genera themselves. This is not the case with botanists, who are generally much better grounded in the philosophy of science. They are careful in giving the synonyms of the families and subfamilies, as may be seen in the works of DeCandolle and others. And it is very desirable that the same attention should be paid to the subject in zoological essays.

The order Cetacea must be divided into two suborders, viz. CETÆ and SIRENIA. I have nothing to add to the arrangement of the second suborder. .

Suborder I. CETÆ.

Skin smooth, bald. Teats two, inguinal. Limbs clawless; the fore limbs fin-shaped; hinder united, forming a forked horizontal tail. Nostrils enlarged into blowers. *Carnivorous.*

1. *The nostrils longitudinal, parallel or diverging, covered with a valve, one often larger and more developed.*

Fam. 1. BALENIDÆ.

Head very large, depressed. Nostrils separate, nuchal. Teeth not developed in the adult. Palate furnished with transverse horny fringed plates of baleen or whalebone.

- a. *Dorsal fin none; belly smooth; baleen elongate, slender; vertebrae of neck united; pectoral broad, truncate at end.*
1. **BALENA.** Pectoral fin moderate. Head one-third of the entire length.

- b. *Dorsal fin distinct; belly plaited; baleen short and broad; vertebræ of neck more or less free; pectoral lanceolate.*
2. MEGAPTERA. Pectoral fin elongate. Dorsal fin low, truncate.
 3. BALÆNOPTERA. Pectoral fin moderate. Dorsal fin falcate, two-thirds the entire length from nose. Vertebræ 46 or 48.
 4. PHYSALUS. Pectoral fin moderate. Dorsal fin falcate, three-fourths the entire length from nose. Vertebræ 54–64.

Fam. 2. CATODONTIDÆ.

Head large, subcylindrical, blunt. Lower jaw narrow. Teeth large, in the lower jaw only, fitting into pits in the gums of the upper one. Nostrils separate, one often abortive. The hinder edge of the maxillary elevated, forming a concavity on the forehead of the skull. Pectoral broad, truncated.

* *Head subcylindrical, truncated; nostril in front of the truncated head; dorsal hump rounded.*

1. CATODON. Head very large, one-third of the entire length of the animal.

** *Head depressed, rounded in front; nostrils in the forehead; dorsal fin falcate.*

2. PHYSETER. Head very large, one-third of the entire length of the animal, rounded, convex above. Teeth conical, compressed. Skull elongate?
3. KOGIA = *Euphyseter*, Wall. Head short, very broad. Forehead convex. Teeth conical, cylindrical. Skull very short and broad.

Fam. 3. PLATANISTIDÆ.

Head small, long-beaked, beak compressed. Teeth in both jaws, at first cylindrical, becoming compressed. Blowers linear, parallel, over the eyes. The sides of the maxilla elevated, forming a vaulted cavity over the forehead. Pectoral broad, truncated.

1. PLATANISTA.

II. *Nostrils united into a single transverse or crescent-shaped blower. Head moderate, more or less beaked. Teeth in both jaws, often deciduous. The pectoral fin lanceolate, tapering.*

Fam. 4. INIADÆ.

The head beaked, beak hairy. Teeth rugulose, crown with an internal process. Back without any fin, keeled behind. Pectoral fin large.

1. INIA.

Fam. 5. DELPHINIDÆ.

Head more or less beaked, smooth. Teeth simple, cylindrical, conical, smooth. Back rounded. Dorsal fin distinct, falcate, rarely wanting.

A. Head more or less beaked; beak of the skull as long as, or longer than, the brain-cavity. Bottlenoses.

a. Pectoral fins moderate, lanceolate, far apart on the sides of the chest; teeth in both the jaws permanent. Delphinina.

1. **PONTOPORIA.** Beak of the skull rather compressed, high. Symphysis of the lower jaw very long. Dorsal medial.
2. **STENO.** Beak of the skull rather compressed, higher than broad. Symphysis of the lower jaw rather elongate. Dorsal medial.
3. **DELPHINUS.** Beak of the skull rather depressed, convex above. Dorsal medial.
4. **DELPHINAPTERUS.** Beak of the skull rather depressed, convex above. Dorsal none.
5. **LAGENORHYNCHUS.** Beak of the skull depressed, expanded. Head shelving in front. Dorsal rather posterior.

b. Pectoral fins small, low down, and rather close together on the middle of the chest; upper jaw toothless; lower jaw with few teeth, sometimes deciduous.

*** Maxillary bones elevated into a crest on the sides behind; teeth two or four, anterior conical. Hyperodontina.**

6. **HYPERODON.** The crests of the maxillary bones thin and wide apart above. The beak of the skull descending downwards. The hinder edge of the skull as high as the crest. Lower jaw rather curved. *Hyperodon rostratum*.
7. **LAGENOCETUS.** The crests of the maxillary bones very thick and close together, especially above, where they are flat-topped. The beak of the skull horizontal. The hinder edge of the skull lower than the top of the crest. Lower jaw straight. *Lagenocetus latifrons*.

**** Maxillary bones simple; teeth, on the sides of the lower jaw, compressed. Ziphiina.**

8. **BERARDUS.** Lower jaw gradually tapering in front. Teeth, two, in the front of the jaw, large, conical.
9. **ZIPHIUS.** Lower jaw gradually tapering. Teeth on the sides of the jaw, large, compressed.
10. **DELPHINORHYNCHUS.** Lower jaw gradually tapering. Teeth on the sides of the jaw, small, conical. (Perhaps the female of the former.)
11. **DIOPLODON.** Lower jaw broad behind, suddenly tapering in front. Teeth on the sides of the jaw, large, compressed. *Dioplodon densirostris*.

B. Head rounded in front, not beaked; beak of the skull scarcely as long as the brain-cavity.

a. Pectoral fins falcate, elongate, low down, near together on the chest; head much swollen; intermaxillary bones very wide, covering the maxilla above; teeth conical; side of maxilla expanded horizontally. Globiocephalina.

12. GLOBIOCEPHALUS.

b. Pectoral fins ovate, wide apart, lateral; intermaxillary bones moderate. Phocænina.

† The lateral wing of the maxilla horizontally produced over the orbit; dorsal distinct; teeth conical.

13. ORCA. Teeth large, acute, permanent. Intermaxillaries moderately wide.

14. GRAMPUS. Teeth early deciduous. Intermaxillaries broad.

†† The lateral wings of the maxilla shelving down over the orbit.

*** Teeth permanent, compressed, sharp-edged.**

15. PHOCÆNA. Dorsal triangular, central.

16. NEOMERIS. Dorsal fin none.

**** Teeth early deciduous, conical; dorsal none.**

17. BELUGA. Teeth in both jaws early deciduous.

18. MONOCEROS. Teeth very early deciduous. Male with a projecting spiral tusk in the upper jaw.

The greatest desideratum of zoology is the power of examining some specimens of the genus *Physeter*, or Blackfish, as it is called by the whalers. There is not a bone, nor even a fragment of a bone, nor any part which can be proved to have belonged to a specimen of this gigantic animal to be seen in any museum in Europe. This is the more remarkable as the animal grows to the length of more than fifty feet, is mentioned under the name of the Blackfish in almost all the Whaling Voyages; and two specimens of it were examined by Sibbald, having occurred on the coast of Scotland. The only account which we have of the animal on which zoologists can place any reliance is that furnished by Sibbald in his 'Little Tractate on Scotch Whales.'

Boyer, in the 'Nova Acta Naturæ Curiosorum,' describes a Whale found at Nice which has been thought to be a Blackfish, on account of the position which he assigns to the blower; but the figure which he gives is so much like a bad design of a *Spermaceti* Whale (*Catodon*) in other respects, that it is doubtful to which genus it properly belongs.

I am aware that in some catalogues of osteological specimens

some conical or small worn-down Whale's teeth are named as if they belonged to this genus, or to the "High-finned Cachalot," as it is called; but these teeth are not to be distinguished from the teeth of the younger true *Sperm Whales*. Mr. Wall, in his account of the Australian *Sperm Whale*, thinks the skeleton of the Whale at Burton Constable is the skeleton of a Blackfish; but Anderson, in his account of this animal, particularly says, "The nostrils were at the end of the snout," and the skeleton is that of a true *Catodon*, as is proved by careful examination.

It is to be hoped that some whaler will preserve the skull, if not some of the other bones, of the animal called the "Blackfish," which, according to the account of Sibbald, must yield a good quantity of spermaceti; for he mentions that four men were seen inside the cavity of the cranium extracting the sperm, or, as he calls it, "the brain." Yet Beale, in his 'History of the Sperm Whale,' specially says, after well describing the difference between the *Sperm Whale* and the *Blackfish*, that the latter does not produce spermaceti (p. 11). But I may observe that, according to Bennett and Nunn, in the Pacific the name of Blackfish is given also to the large Dolphin described by me as *Globiocephalus macrorhynchus*.

ON THE EYES OF THE EMYDIDÆ AND BATRACHIA.

BY DR. J. E. GRAY, F.R.S., ETC.

There is no character that an animal offers that is not worthy of study; and my attention has lately been called to the eyes of the freshwater Tortoises, and they have afforded me some information which I believe to be important. All the paludinal Terrapens which I have been able to examine have a large square dark spot on each side of the iris. This spot, with the pupil, forms a dark band across the eyes. I have observed this to be the case in the species of *Emys*, *Pseudemys*, and *Chrysemys*; and on looking at Holbrook's 'North American Herpetology,' where the animals are all figured with care from life, we find that he represents and describes all the North American species of *Emydes* as having this band across the eye. I may observe that I have also seen it in a South American Tortoise, which I have called *Geoclemys annulata*; and I think it is also found in *Testudo scabra*, another tropical American Terrapen with separate toes. These animals have been called *Rhinoclemmys* by Fitzinger. They are probably a natural genus, characterized by this peculiarity in the eyes. All the American species of *Geoclemys*, the two species of *Cistudo* figured by Holbrook, the estuarine Terrapen *Malaclemys*, the aquatic Box-Tortoises *Kinosternon* and *Arochelys*, and the Lacertine Terrapens *Chelydra* and *Macrolemys*, have an annular iris without any interruption. It will be interesting to observe the eyes of the Asiatic and European species; but this can only be relied upon in living specimens, as the spot on the angle of the eye is not to be observed in the specimens preserved in spirits, where only the circular pupil is distinctly marked even in the American *Emydes*.

P.S. When this paper was read, it was observed that the Tritons

and Toad had the same peculiar spot on the sides of the iris, and that it was common to the Batrachia. This is a mistake; the European and North American species of *Bufo*, *Rana*, *Hyla*, and *Hylodes* have an oblong-transverse pupil, with an oblong ring-like iris, the upper portion of which is often differently or more brightly coloured than the lower; but this form of pupil is not universal in the tailless Batrachia; for, according to Dr. Holbrook, the genus *Scaphiopus* has a small circular pupil, and the iris divided into four equal parts by black radiating lines. According to the figures of the same author, who had all the species figured from life, the North American Salamanders and Tritons, the *Amphiuma*, *Menopoma*, *Siren*, and *Menobranchus*, all have small circular pupils, with an annular iris. The *Triton cristatus* of England, *T. marmoratus* of Spain, and *T. alpestris* of Germany, have a circular ring-like iris; and the only Batrachians which appear to have the spot on each side of the iris, forming a band across the eyes, are the English *Lophinus punctatus* and *L. palmatus*, the band on the eyes looking in these like a continuation of the dark streak on the side of the head. I may add that the best character for the distinction of these two species, which are often found in the same pond, is, that in *L. punctatus* the crest of the male is scalloped on the edge, and high in front; while in *L. palmatus* it is low in front, and higher behind, and has a smooth straight upper edge. The tail of the latter is also always truncated, and usually appendaged at the tip.

ON THE SPECIES OF ZOSTEROPS INHABITING CHINA AND JAPAN,
WITH THE DESCRIPTION OF A NEW SPECIES. BY ROBERT
SWINHOE, F.Z.S., ETC.

The genus *Zosterops* is represented in China by two species, one inhabiting South China and the island of Formosa, the other North China, from Shanghai northwards into Amoorland. The species peculiar to Japan has been described by MM. Temminck and Schlegel in the 'Fauna Japonica,' and is allied to both the Chinese species, but quite distinct from either. I proceed to characterize briefly the two Chinese species.

ZOSTEROPS SIMPLEX, Swinhoe, Ibis, 1863, p. 294.

Similis Z. palpebrose ex India, sed major; supra magis viridis; alis caudaque saturatioribus.

This species ranges in China from Canton to Foochow, and perhaps a little higher; but not to Shanghai, where it is replaced by the following. In Formosa it is also an abundant resident. On its nesting and habits I have already written much in the 'Ibis,' and therefore will not here repeat my remarks. It has its nearest ally in *Z. palpebrosa* of India, being, like it, light grey on the under parts. An occasional specimen or two, however, may be picked out of my Amoy series with a tinge of chestnut-brown on the under parts, showing the tendency of the species towards the Japanese *Z. japonica*. Some have the belly deeper grey than others. The yellow on the throat

and vent varies in intensity, as also does the green of the upper parts; but these are chiefly distinctions of sex and age. I have one pale, almost yellow variety, procured by Capt. Blakiston at Canton. All the adults have the black lore- and eye-line peculiar to so many of this group. I have specimens from Hong Kong, Macao, Canton, Amoy, Foochow, and Formosa; and they all agree in essential characters.

ZOSTEROPS ERYTHROPLEURA, n. sp.

Z. chloronotus, v. Schrenck (nec Gould).

Lateribus utrinque saturate castaneo-rufis.

Long. ælæ $2\frac{1}{2}$ poll., caudæ 1·7.

The distribution of this species extends from Shanghai into Amoorland. I had, until lately, confounded it with the *Z. japonica* of Japan; but while on a visit to M. Jules Verreaux at Paris, I had the pleasure of examining for the first time a veritable Japanese specimen, and of comparing it with North China skins. The difference in the two birds is striking. Both have, like the preceding, black markings on the lore- and partly round the white eye-ring. The under parts of *Z. japonica* are a dull light brownish chestnut, while the flanks of this species are of a deep rusty chestnut. This bird is larger and longer-winged than our South China species, but is exceeded in both by the Japanese. I here exhibit two specimens from Shanghai, kindly lent me by M. Jules Verreaux, and one from Tientsin. The two former are much brighter on the flanks than the latter; but as they are both males, and our Tientsin bird is a female, the difference may be only a sexual one, and not one of locality. What could have induced M. v. Schrenck, in his 'Amoorland,' to confuse this species with the *Z. chloronota*, Gould, of Australia, I cannot understand. I am enabled to produce a specimen of this last from M. Verreaux's collection, the shape of the bill and head of which, as well as the dull sordid colour of the plumage, show at once a marked difference from the Chinese bird. Indeed there are many species from Asia and Africa far more closely allied to our species than is the *Z. chloronota*. For comparison with the two Chinese species, I am enabled to bring before the Society the *Z. palpebrosa*, Gray, of India, the *Z. japonica*, T. & S., and two Australian species, *Z. chloronota*, Gould, and *Z. cærulescens*, Blyth. I think all practical ornithologists will agree with me in considering the three forms of Eastern Asia as distinct *inter se*, and from all others of this numerously represented group. As I have never met the North China species alive, except as a cage-bird, I have nothing special to relate regarding its habits.

June 9, 1863.—John Gould, Esq., F.R.S., in the Chair.

DESCRIPTIONS OF NEW SPECIES OF THE FAMILY UROPELTIDÆ
FROM SOUTHERN INDIA, WITH NOTES ON OTHER LITTLE-
KNOWN SPECIES. BY CAPTAIN R. H. BEDDOME.

Genus *SILYBURA*.

1. *SILYBURA* SHORTII.

Head-plates as in *S. brevis*, but vertical, 6-sided, and occipitals

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pointed behind ; caudal disk very large and well-defined ; scales very strongly 2-3-keeled ; terminal scale large, slightly bicuspid. Scales of the body in 17 rows, on the neck in 19. Eye very large. Total length 9 inches. Colour blackish, with large dull yellowish white mottlings (the two colours nearly equally divided) ; tail beneath black, with a yellowish band on each side. Abdominals 134 ; subcaudals 10.

Shevaroy Hills (4500 feet elevation). Forwarded to me by Dr. Short.

2. *SILYBURA OCELLATA*.

Rostral pointed and much produced ; nasal scutella meeting behind the rostral, and separating it from the frontals ; eye very small, obscure, in front of ocular shield ; other shields and labials as in the genus ; scales round the neck in 18 rows, round the trunk in 17 ; caudal disk not very clearly defined ; scales 2-5-keeled ; terminal shield entire, or slightly 2-3-pronged ; abdominals 199 ; subcaudals 8 or 10 pairs, some generally entire. Total length 14½ inches. Colour of the body of the male yellowish, becoming gradually brown near the head and tail, of the female dull brownish, of the young dark purplish brown ; all banded with transverse rows of four or five black-edged white or yellow spots (like eyes), generally rather irregularly placed. Sides of the belly with transverse, very irregular-shaped, yellow or white blotches, rarely meeting over the abdominals, and forming a transverse band.

Walaghat, on the western slopes of the Nilgherries, at an elevation of 3500 feet, in the dense moist forests. I procured three specimens—male, female, and young.

3. *SILYBURA BREVIS*, Günther.

The specimen differs from the one described by Dr. Günther in having sixteen rows of scales instead of seventeen, and in the terminal scale of the tail being entire and not bicuspid.

I procured this specimen on the Nilgherries ; the one described by Dr. Günther was found on the Anamallays.

4. *SILYBURA NILGHERRIENSIS*.

Scales in 17 rows ; anal large, bifid ; subcaudals 9 ; snout obtuse ; rostral far produced back between the nasals ; nasals just meeting behind the rostral ; vertical 6-sided, pointed in front and behind ; eye rather large, in front of ocular shield ; caudal disk well defined ; scales very prominently 2-3-keeled ; terminal scale ending in two points. Colour of the body of an indigo-hue, with small dull yellow blotches ; belly dull yellowish. Length 17 inches ; circumference 3 inches.

Ootacamund, Nilgherries, 7000 feet elevation.

This is by far the largest Earth-snake we have in Southern India.

It is possible that *S. brevis* may be the young of this species : they are, however, found at different elevations ; and without intermediate forms I cannot venture to unite them, that being the smallest Earth-snake in our presidency, and this the largest. There is, however,

scarcely any difference in the shields of the head, though the head of *Silybura brevis* is broader.

5. *SILYBURA BEDDOMII*, Günther.

I have lately procured numerous specimens of this Snake on the Shevaroy's, elevation 4500 feet. I have also found it in the Mudumallay Forest, elevation 3000 feet. The spots on the scales are yellow, turning white in spirits.

Note.—*Silybura brevis*, *nilgherriensis*, *Shortii*, and *macrolepis* (a Ceylonese species) have a well-defined head, with broad snout and a large eye. *Silybura Elliotti*, *Beddomii*, and *ocellata* have a pointed snout and a small eye (as in the genus *Rhinophis*).

6. *RHINOPHIS SANGUINEUS*.

Scales of the body large, in 15 rows; of the anterior portion of the trunk sometimes in 17; rostral much produced, very sharp, conical, horny, produced back, and covering the conjunction of the nasals; nostril in front of nasal shield; eye very small and obscure, in front of ocular shield; four upper labials, 1st small, 2nd, 3rd, and 4th large; caudal disk nearly as long as tail, oblong, covered with excrescences, a red streak down the centre and one on each side. Colour of the body bluish black; belly bright red, with blackish mottlings; anal bifid; subcaudals of the male 9 or 10 pairs, each with 4 to 6 keels, and some of the approximated ventral plates and a few of the two lowest rows of scales also keeled; female subcaudals 6 or 7. Total length of large male 13 inches, female 10 inches; circumference 1 inch; abdominals 195.

The brilliant red colour of the abdomen fades in spirits.

I procured numerous specimens of this species at Cherambōdy in the Wynand (Malabar), elevation 3500 feet; they were all dug up in one spot. I have not met with it elsewhere.

7. *RHINOPHIS MICROLEPIS*.

Scales of the body small, in 15 rows; of the anterior portion of the trunk in 17, of the neck in 19. Caudal disk oblong, orbicular, one-half the length of the tail, covered with excrescences, which are confluent into streaks; subcaudals 10; anal bifid; head-plates as in *R. sanguineus*, but rostral less sharp. Colour of the body greyish black, with indistinct dull yellowish white mottlings; belly yellowish white, with dark mottlings; tail beneath yellowish, with a broad black spot. Abdominals very small, 199. Total length 6 inches; circumference $6\frac{1}{2}$ lines.

I procured this (a solitary specimen) in the Wynand, elevation 3500 feet.

Genus *PLECTRURUS*.

* *Eye rather large, with a supraorbital shield.*

8. *PLECTRURUS PERROTTETI*, Gray, P. Z. S. 1858, p. 265.

This is most abundant on the tops of the Nilgherries, 7000 to 8000 feet; it is dug up in gardens, and found under the turf and

under stones. My largest specimen is 14 inches long; it rarely, however, attains that size.

9. PLECTRURUS GUENTHERI.

Scales of the neck in 17 rows; anterior portion of the trunk in 13 rows, of the rest of the body in 15 rows; head-shields as in *P. Perrotteti*, only the rostral is not produced so far back. All the scales of the tail 5-6-keeled, and some of the approximated scales of the body also keeled; terminal scale of the tail with four sharp points, and covered with small tubercles; abdominals 172, and a bifid anal; subcaudals 12. Total length 13 inches, circumference $1\frac{1}{2}$ inch. Colour of the body a bright reddish purple; belly yellow, the yellow colour rising up on the sides of the trunk into regular pyramid-shaped markings, and the purple colour descending in the same way down to the abdominals.

I procured this very fine species in the moist forests at Walaghat, on the western slopes of the Nilgherries (3500 feet elevation). I have great pleasure in naming it after Dr. Günther.

**** Eye small, no supraorbital shield.**

10. PLECTRURUS WYNANDENSIS.

Scales round the body 15, round the neck 16 or 17; rostral scarcely produced back between the nasals; *no supraorbital*; muzzle more obtuse than in *P. Perrotteti*; *eye small*; subcaudals 11 pairs; anal large, bifid; tail compressed; scales smooth, terminal spinose, tail ending in a single horny point. Colour bluish black, with broad white blotches on the belly, which become larger and more numerous towards the tail; tail uniform bluish black.

Wynand, elevation 3500 feet.

11. PLECTRURUS PULNEYENSIS.

Rostral rather obtuse, produced back between the nasals, and touching the frontals, nasals not meeting; *eye small*, in front of the ocular shield; *no supraorbitals*; vertical 6-sided; occipitals rounded behind; 4 upper labials. Scales round the neck 19, round the body 17; subcaudals, male, about 12, female 6-8. Tail compressed, ending in a small spinose keel, more or less bicuspid. Scales of the tail all smooth. Colour uniform earthy brown; a lateral bright yellow streak from the labials continued on each side of the trunk, about 1 inch or $1\frac{1}{4}$ inch in length; a few minute yellow specks on the back; belly with broad bright yellow transverse bands, very irregular as to number and shape; yellow markings about the vent and tail.

Very abundant on the Pulney Hills, 7000 to 8000 feet, where it takes the place of *P. Perrotteti* of the Nilgherries; in habits, &c. exactly the same as *P. Perrotteti*.

The very brilliant yellow fades in spirits.

These last two species differ from the typical form of this genus in their much smaller size and in the absence of a supraorbital shield. As, however, they have the same compressed tail, I prefer keeping them in this genus to making a new genus for them.

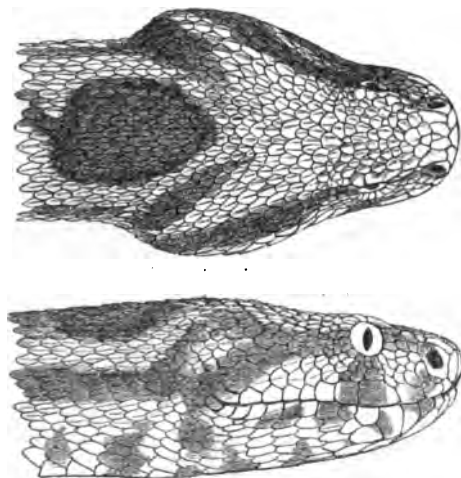
ON A SPECIES OF *VIPERA* HITHERTO UNKNOWN.

By E. D. COPE.

VIPERA CONFLUENTA, sp. nov.

Head much longer than broad, covered with small scales, which are more or less keeled as far anterior as the postfrontal region. Superciliaries little developed, once or many times divided. Scales of the upper surface of the muzzle larger; a well-developed supranasal. Prenasal large, erect, undivided; postnasal developed in front of, and narrowly superior to, the nostril. Three rows of scales between the orbits and the superior labials. The latter are eleven in number, the fourth longest, the first in contact with the prenasal. Rostral higher than broad. Inferior labials fourteen, fifth largest. Scales of the body in 25 rows, all keeled, never spiniferous. Gastrosteges 180; urosteges 48. Length from muzzle to rictus $1\frac{1}{4}$ inch, from muzzle to vent $30\frac{1}{2}$ inches, from vent to end of tail $4\frac{3}{8}$ inches.

General ground-colour brownish yellow; belly paler. A broad undulating brown band, resembling a confluence of alternate rounded spots, extends from the nape to the end of the tail. A dark brown lateral streak, which is interrupted at regular intervals, extends



throughout the greater part of the length. Labial regions yellowish; a brown band from orbit to angle of mouth; a brown spot below orbit.

The habitat of this species is not known, but is probably Africa. Its nearest ally is the *V. Libitina*, with which it forms a section of the genus characterized by a superciliary plate more or less subdivided, and leading off to *Echidna*. In the writer's opinion, the genus *Vipera* is to be separated from *Echidna* by its large prenasal plate, and postnasal slightly developed above the nostril, which is always

lateral: in *Echidna* the prenasal is replaced by scales, and the post-nasal is much developed above the nostril, which is usually vertical; in *E. Atropos* the nostril is vertico-lateral.

One specimen of this *Vipera* belongs to the Academy of Natural Sciences of Philadelphia, and another is in the British Museum. For an opportunity of examining and figuring the latter, my acknowledgments are due to the distinguished officers of the institution, Drs. Gray and Günther.

RECORD OF THE PERIOD OF GESTATION OF CERTAIN RUMINANTS WHICH BREED IN THE SOCIETY'S GARDENS. BY P. L. SCLATER, M.A., PH.D., F.R.S., ETC., SECRETARY TO THE SOCIETY.

The period of gestation of certain animals of the class of Ruminants which habitually breed in the Society's Menagerie has been ascertained with tolerable exactness. Of course the period is slightly variable; but the times given in the following list are, on the average, very faithfully adhered to.

Fam. CERVIDÆ.

Wapiti Deer (<i>Cervus canadensis</i>)..	} 8 months.
Persian Deer (<i>C. Wallichii</i>).....	
Barasingha Deer (<i>C. Duvaucelii</i>)..	
Japanese Deer (<i>C. sika</i>)	
Sambur Deer (<i>C. Aristotelis</i>)	
Rusa Deer (<i>C. rusa</i>).....	
Hog Deer (<i>C. porcinus</i>)	
Axis Deer (<i>C. axis</i>)	

Fam. CAMELIDÆ.

Lama (<i>Auchenia glama</i>)	} 11 months.
Alpaca (<i>A. pacos</i>).....	

Fam. CAMELOPARDIDÆ.

Giraffe (<i>Camelopardalis giraffa</i>) ..	15 months.
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Fam. BOVIDÆ.

Punjab Wild Sheep (<i>Ovis cycloceros</i>) }	4 months.
Moufflon Sheep (<i>O. musimon</i>).... }	
Leucoryx Antelope (<i>Oryx leucoryx</i>)	8 months.
Eland Antelope (<i>Oreas canna</i>) ..	9 months.
Nylghai Antelope (<i>Portax picta</i>)..	Between 8 and 9 months.

The Hippopotamus has never bred with us; but I may state that the period of gestation in this animal is known to be short. The female in the Amsterdam Gardens, which has twice produced young in that establishment, went only 7 months and 16 days on the first of these occasions, and 7 months 20 days on the second.

MISCELLANEOUS.

On the Classification of the Gasteropodous Mollusca.

By M. GOURIET.

A DIVISION of the Gasteropoda founded on the generative organs presents this radical defect, that many species reputed to be hermaphrodite are constantly being found to be unisexual, and further that Mollusca evidently nearly allied, such as the *Helices* and *Cyclostomata*, are necessarily separated on the consideration of their sexual organs.

Therefore most authors have justly selected the respiratory apparatus as the basis of classification, since the position of this organ determines the position of the heart and generally that of the anus. In the classifications generally followed, such as that of Cuvier, however, orders are found to be established upon various characters of unequal importance although generally derived from the respiratory apparatus. Thus the Nudibranchs are generally characterized by their uncovered branchiæ, although with a restriction for the separation of the Inferobranchs, which are really also Nudibranchs. Elsewhere only the pectinated form of the organs is considered, as in the Pectinibranchs, although in other divisions, such as the Tectibranchs, this form of the branchiæ sometimes occurs. The term Tectibranch also conveys to the mind the same sense as Scutibranch. The expression Tubulibranch would seem to indicate a tubular form of the branchiæ, when it only refers to the tubular form of the animal. In the case of the Heteropoda the branchiæ are set aside, and a character of subordinate value, the form of the foot, is set on the same level as those of the preceding divisions. The word Cyclobranch would perhaps be the most suitable, but for the confusion between them and the Inferobranchs, if taken literally.

In fact, in the establishment of orders, the position and form of the branchiæ, the form of the foot, and the general form of the animal have all been placed in the same rank, without assigning to any one of them a marked preeminence over the others. To remedy this defect the author proposes, taking the respiratory apparatus as his basis, to select the most important of its characters, and to establish the primary divisions upon this. He considers the position of the branchiæ to furnish the most important character. The branchiæ can only occupy three positions : they are either

Completely external ;

Or completely internal, and then concealed in a cavity which is itself covered by a shell which usually envelopes the animal ;

Or simply protected by an imperfect test, a condition intermediate between the two preceding.

Hence, after the separation of the Pulmonata as a distinct subclass, we get three great divisions,—the Exobranchs, the Stegiobranchs, and the Endobranchs.

I. The order of EXOBRANCHS may be subdivided, according to the point of the surface upon which the branchiæ are inserted, into—

1. *Epibranchs*, which have them on the back (*Doris*, *Glabellina*, &c.).
2. *Peribranchs*, which have them round the mantle (*Tritonia*, *Glaucus*, *Scyllæa*, *Plocamocera*, &c.). The *Eolidæ* would be allied to both the Epibranchs and Peribranchs.
3. *Hypobranchs* (the Inferobranchs of Cuvier). The *Thetydes* would approximate all three Orders.
4. *Pleurobranchs*, which have the branchiæ on the side (*Pleurobranchus*, *Pleurobranchidium*, *Laniogera*, &c.). The Pleurobranchs lead both to the Stegibranchs by their small test, and to the bulk of the Endobranchs by the pectinated form of the branchiæ.

II. The order of STEGIBRANCHS (στέγη, a roof) would include four divisions :—

1. *Stegibranchs* proper, corresponding to the Tectibranchs of Cuvier (without the Pleurobranchs) and to the Scutibranchs of the same author.
2. *Cyclobranchs*, corresponding with Cuvier's group.
3. *Heteropod Stegibranchs* (Heteropoda of Cuvier), which, if we take *Carinaria* as the type, have the heart and branchiæ within a small shell. The shellless Heteropoda must be left with *Carinaria*.
4. The *Ianthinæ*, which have their branchial laminæ half concealed by the shell, and which, like the Heteropoda, deserve to be separated on account of their curious appendage. Their pectinated branchiæ also form a transition from the Stegibranchs to the Endobranchs.

III. The order of ENDOBRANCHS would correspond with the Pectinibranchs and Tubulibranchs of Cuvier. They may be divided into *Turbinata* and *Tubulata*.

1. The *Turbinata* (the old Pectinibranchs) might retain the old Cuvierian subdivisions, or the much more natural division of De Blainville into Siphonobranchs and Asiphonobranchs.
2. The *Tubulata* are the old Tubulibranchs.

Comptes Rendus, Nov. 16, 1863, p. 826.

Fucus anceps, Ward & Harvey.

"Notwithstanding all that has been said *pro* and *con*, I have now to inform you that the Kilkee *Fucus* is neither *F. distichus* nor yet *F. fuscatus*, nor yet any species known to Prof. Agardh, from whom I have just received a specimen of the true *F. distichus* of the elder Agardh; and so, being constrained to give it a name, I propose to call it *Fucus anceps*, Ward & Harvey; and I request you to make known this *alias* to all to whom you have (on my authority) given the wrong name. This *Fucus* seems to combine the characters of the ribbed and ribless species, and therefore it may with propriety be named *F. anceps*."—Prof. J. H. HARVEY to Dr. Gray, Dec. 26, 1863.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 75. MARCH 1864.

XX.—*On the Red Crag and its Relation to the Fluvio-marine Crag, and on the Drift of the Eastern Counties.* By S. V. Wood, Jun.

[With a Map, Plate XVII.]

SOME observations made during a visit to the Red-Crag beds disclosed such peculiar conditions of structure that I was induced to enter upon a careful and minute survey of the whole Red-Crag area. The result of that survey, with the observations that I have been enabled to make upon the Drift-beds of the counties of Essex and Suffolk, form the subject of this paper; and they have led me to the conclusion that in the Red Crag (once regarded as of Miocene age) we have the initiatory stage, in England at least, of that series of events which, chiefly studied under the term *drift*, began by the encroachment upon the land of England of a bay of the Northern Ocean, progressed by the extension of that bay into what now forms the Eastern Counties, and eventually involved a far more extensive area in a submergence beneath the sea that furnished the ice-borne sediment and detritus known as the northern Clay-Drift.

I have thought it more convenient to embody in an appendix a list of the various sections of Red Crag examined by me. They are taken from every part of the Red-Crag area, and comprise, with the exception only of Felixstowe, almost every Red-Crag exposure between the Alde and the Orwell, as well as several south of that river.

It will be perceived, from the diverse shading upon the map (Pl. XVII.) accompanying this paper*, that the Red Crag is divided

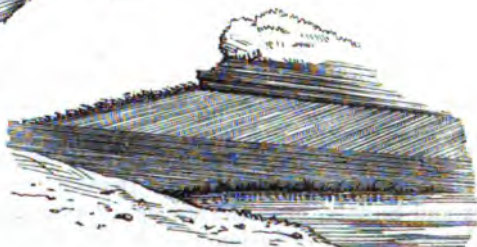
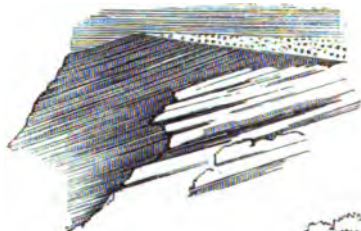
* This map, in so far as concerns the division between the fifth-stage Crag and the beach stages, must be taken as a very imperfect approximation, the chief part of the Crag area being hidden under the great heaths formed of the lower-Drift beds; the object is to show the features presented by the two Crags in their mode of deposit. The district on the east of the Deben, between Woodbridge and Ramsholt, may be taken as a tolerable approximation to exactness.

into two structural parts. These parts are respectively Crag possessing none of the characters of a deposit formed under water, and Crag with the usual characters of a water-deposit. There are to be observed in one pit at Hollesley (see woodcut *infra*) four

Pit near Hollesley.

North end of pit, looking N.W., fourth and fifth stages.

[This section is in its true vertical position relatively to the section below.]



South end of pit, looking N.E. Three Beach stages.

distinct stages of the first-mentioned Crag, one over the other, covered partially by the Crag with the character of a water-deposit; and in consequence of that quintuple exposure, I shall, for convenience, distinguish the one division as the beach stages of Crag, and the other as the fifth or horizontal Crag.

Of these beach Crag the three inferior stages are not altogether constant in their direction, although, where exposed, they have for the most part a distinguishable uniformity of direction in the inclination of their planes of stratification. There is only one other section (that at Brockstead in Sutton) where so many successive beach-stages are exposed. The less frequent exposure of the more inferior stages, or at least of the two lowest, and the extent to which they have suffered from the denudation consequent upon the formation of each succeeding stage, render it difficult satisfactorily to divide any of them, except the uppermost, into stages capable of identification with each other at every exposure. This, however, is not the case with the fourth or uppermost of the beach stages. From the great thickness often exhibited by this stage, and from the more partial denudation by a succeeding stage to which it has been subjected, this fourth-stage Crag presents the means of accurate identification.

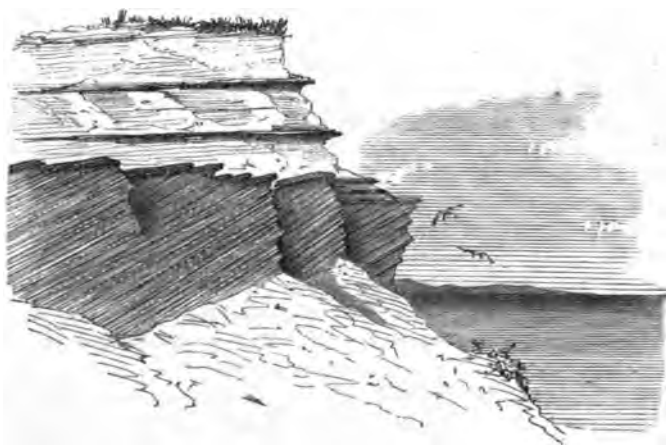
The angle made with the horizon by the planes of stratification of the fourth stage presents everywhere south of Hollesley a remarkable uniformity, varying between 25° and 35° ; and this Crag also possesses a direction of inclination in its planes most unvariable, being from N.N.E. to S.S.W.; its surface, where not covered by the fifth stage, is generally deeply eroded; and its thickness in some places, as at Newbourn, is not less than 20 feet. North of Hollesley, beach stages are exposed in several sections in Butley and Sudbourn parishes, but, from the absence of that uniformity of direction possessed by them in the more southerly exposures, they do not present the same means of identification.

No one who has, as I have done, measured the angles made by the laminæ with the horizon, in the sections presented by the beach Crag, could suppose these Craggs to have been deposited under water; the constancy of direction and the parallelism of their planes precludes any idea of false bedding, so called—a feature common enough in the horizontal or fifth-stage Crag and in some parts of the overlying sands. In some places, as at Trimley, these beach Craggs contain no shells for a space, and then the shelly laminæ recur; but both have their laminæ inclined alike in all respects.

The subjoined actual copies of some of the more characteristic sections of beach Craggs, at places selected for their great distance from each other, will afford an idea of their characters.

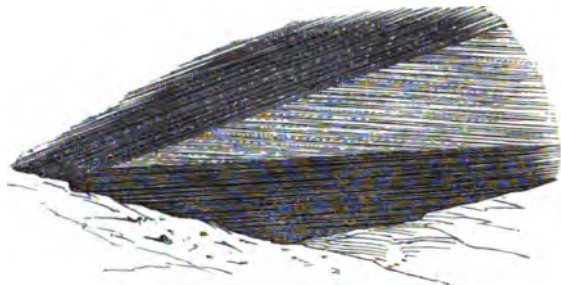
Bluff in Bawdsey Cliff.

Fourth stage. Crag overlain by lower Drift.

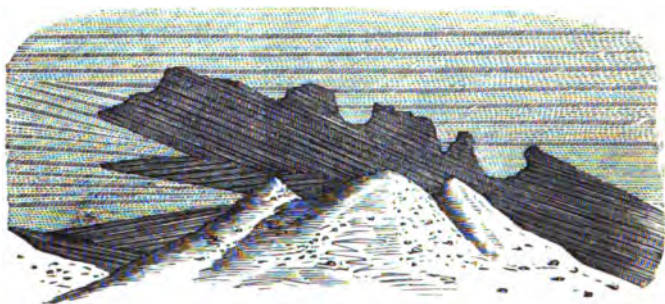


N.B. The inclination of the laminæ is here represented greater than it should be; the inclination is about 35° .

Pit at Crag Hall, Tattingstone.
Three Beach stages.



Beach Crag overlain by lower Drift, in Pit near Melton Church.



In one place only (with the exception of a bed peculiar to Walton Naze, and presently referred to) could I find any indication of a water-deposit. This section is at Butley, near the Abbey: a bed is there exposed, underlying a true beach stage, more sandy, and stratified in a peculiar elliptical manner, resembling the grain of wood where knots have been cut through; and it appears to me to afford indications of having been produced in a very shallow eddy. Nothing also is clearer than that this inclined stratification, which at first sight resembles horizontal strata tilted by upheaval, is due to no elevating action, as, independently of the great area over which the fourth stage extends being inconsistent (on such an hypothesis) with its limited thickness, the inferior stages on which it rests often exhibit a less inclination than does the overlying fourth stage.

At Walton Naze, however, underlying the fifth stage and two subjacent beach stages, a bed of Red Crag occurs, lying on the London Clay, which differs entirely from any other Red Crag known. It is destitute of stratification, and is of a greyish-brown colour. It alone, of all the Red-Crag beds, yields shells in the condition in which they died—bivalves not unfrequently

with both valves united, and univalves with the pullus unimpaired. This bed, lying at the southernmost extremity of the deposit, presents the only instance of Red Crag, other than that of the fifth stage, which has been deposited under water; and it is destitute of those derivative Coralline-Crag shells that so largely contribute to make up the mass of the rest of the Red Crag. The rest of the Red Crag, occupying as it does a hollow between the Coralline Crag on the one side and the London-Clay shore on the other, is largely composed of the degraded material of the Coralline Crag, as well as having been in each successive stage largely made up of the degraded material from the preceding stages.

The fifth stage, or horizontal and water-deposited Crag, does not uniformly cover the underlying beach stages; these, deeply furrowed on their surface, are very frequently covered only by the red sands of the lower Drift; while the manner in which the fifth stage spreads up to and over the beach stages (almost always the fourth) shows that it has been formed in channels cut through the pre-existing beach, and afterwards silted up. It is under this fifth-stage Crag alone that the workings of phosphatic nodules, so far as I have seen them, occur*. I learn from Mr. Colchester that this material has been obtained from beneath the Coralline Crag; but not only have all the nodule-workings in the Red Crag that I have visited been under this stage, but wherever the beach stages are to be found resting on the Clay, as at Bawdsey and Walton, the nodule-band does not occur. This band, often of nearly a foot in thickness where worked, and largely intermingled with rolled *Pectunculi*, thins off gradually as the fifth-stage Crag leaves the Clay and rises over the beach stages. I have traced it so rising in numerous instances. At the watercourse near Methersgate Dock, Sutton, it appears overlying beach stages, whence, going eastwards, the extensive (but now discontinued) nodule-workings immediately over the London Clay occur; and on quitting them, the band rises again, on the eastern side, over beach stages. At Bawdsey the band first occurs high up in the cliff, covering beach stages, and descends to the southwards towards the river, nearer to which, and inland, extensive workings have taken place. At Tattingstone it occurs at the top of the section, underlying fifth-stage and covering beach Crags, while at the junction there of the beach Crag with the Coralline Crag it is

* At the base of the beach Crags small nodules may be found, forming a thin band interspersed with Crag; but they are intermixed with pebbles in such proportion that the pebbles are to the nodules as nearly 10 to 1. There is no similarity whatever between these minute bands and the true *Pectunculus*-vein of nodules.

absent. The portions of this band rich enough to work are those resting on the clay, being the deeper parts of the channels thus eroded through the older beach, the band becoming poorer as it rises up the sloping sides formed of beach Crag. Many of the sections of this fifth stage expose a thickness of not less than 20 feet of it; and one near Sutton Hall (now open) is a furlong and a half in length, and full of the most intricate false bedding. An interesting illustration of one of these channels is afforded by the pits at Foxhall and Bucklesham. (See Section A.) The *Pectunculus*-band with nodules invariably underlies the fifth stage only where that stage rests on the clay; when the stage rises over the beach Crag, the nodule-band either becomes feeble or disappears altogether. The Crag of the fifth stage may always be detected at a glance, and distinguished from the lower stages by its horizontal stratification and the contrast it presents to the underlying beach stages. The Crag of the fifth stage, however, does not resemble the genuine deposit underlying the beach stages at Walton Naze by containing shells in the state in which they died; on the contrary, although manifestly water-deposited, the organic remains in it are as worn and travelled in appearance as those in the beach stages, and show their origin to have been mainly from the material of the older beach stages through which the channels have been eroded. While this seems to have been the mode of formation of the fifth-stage Crag, that of the beach stages seems to have resulted from a sea forcing itself backwards from the shore by the growth of the beach that it heaped up, until, by a slight subsidence, the sea, recovering its place, planed down the old beach into the small thickness that we find the lowermost stages now presenting, and recommenced the process of beaching up and forcing itself back.

The fifth stage, south and west of Chillesford, is everywhere divided from the overlying red sands by a line of erosion, sometimes very faint, but generally strongly marked, and often, like the surface of the fourth stage where overlain only by the lower-Drift sands, irregular and deeply cut in. At Chillesford, however, the fifth stage (under which I could not detect the nodule-band) resting upon a beach stage, passes up, without the slightest break or line of erosion, into the micaceous sands and laminated clays first noticed by Mr. Prestwich in 1849, and which have as their characteristic fossil the *Mya truncata* in the position in which it lived; and these sands and clays, again, pass up in other places (as at Iken and Aldbro'), without a break, into the extensively developed sands of the lower Drift. At Chillesford (and it is here alone that I have been able distinctly to recognize it) we have the unbroken passage upwards of the fifth-stage Red Crag

into beds that unquestionably underlie, and pass gradually into, the great deposit of sands and gravels which cover the whole of Suffolk and are extensively developed in Norfolk and Essex, and which themselves pass upwards, without the least break, into the more widely spread northern Clay drift.

The geological conditions under which the peculiar formation of beach Crags was accumulated demands a special consideration, from the circumstance that it seems to afford a solution of the question of the relationship between the Red and the Fluvio-marine Crag. The latter, occurring at intervals from Norwich to Thorpe, near Aldbro', ceases almost at the place where the Red Crag first appears. The absence of any superposition in the two formations has hitherto left their relative ages in doubt; and since fluvio-marine conditions obtain in the one, and purely marine conditions in the other, inferences that might otherwise be drawn from a comparison of their fauna are consequently of less value.

The unvarying N.N.E. to S.S.W. direction presented everywhere south of Hollesley, and from Melton and Bealings on the west to Bawdsey Cliff on the east, is precisely that possessed by the trend of the Coralline Crag, uncovered by any Red beach Crag, from the point where it first comes to the surface north of Aldbro' to its termination at Gedgrave. This also is the direction which was detected by Sir Charles Lyell in the cliff of Coralline Crag buried in Red Crag at Sutton. According to the view I take, it is, in reconstructing the bay of the Red Crag, only necessary to assume the prolongation of that ridge or barrier of Coralline Crag in the same direction from Gedgrave southwards, over what is now covered by the sea. (See the continuation-line suggested on the map.) The production of this ridge, composed as it is of the Bryozoon-bank of hard rock, capable of resisting the waves, would give rise to a long tongue-shaped bay running up between it and the shore-margin of soft London Clay, in which these successive accumulations and destructions of beach-deposit might readily take place during slight intervals of subsidence. The direction of beaching up, then, would be determined by the particular contour of the bay and the direction from which the sea had access to it. The evidence available to show that the beach Crags never covered the greater part of what now remains of this barrier, although necessarily only negative, is of the strongest character that such evidence can afford. Firstly, it is along this line, and *there only*, that the Coralline Crag occurs uncovered by the Red; secondly, the Coralline Crag consists of three parts,—the lower of sandy beds, rich in Mollusca, preserved nearly as they lived; the middle of the rocky Bryozoon-bank; and the upper of a thin bed, some

8 or 4 feet thick, formed apparently of the disintegrated material of the Bryozoon-bank, and destitute of perfect fossils; this upper bed exhibits indications of having, during the period of its formation, been beached up, somewhat similar to those afforded by the lower stages of the Red Crag, suggesting comparisons with the beach of decomposed coral fringing existing coral shores. Now over this line, this thin and easily denuded upper part remains intact, with the Chillesford beds in places resting upon it; and it is almost inconceivable that so tranquil a sea as that depositing the Chillesford beds could have so evenly removed every trace of Red Crag, and spared this perishable upper portion of the Coralline Crag. It is also worthy of note that over this area the lower beds of the Drift sands exhibit peculiar oblique stratification not observable elsewhere, as though this ridge were continued as a shoal in the Drift-sea and produced a quasi-beaching of the sand over it at low water.

These arguments might be pursued further; but those given, I venture to think, justify me in the view I take that this ridge shut in the Red-Crag bay during the whole of the deposit of the beach Crag. The Chillesford Sands and Clays sweep round the Coralline-Crag ridge, but do not cover every part of it: their absence may be due to denudation taking place at the time when the existing valley-system was formed; but I am inclined to think that these beds even, although extensively overlapping those of the Red Crag, as well of the fifth as of the beach stages, did not quite cover the Coralline-Crag ridge; and, although I have not ventured so to represent them in the section, they may possibly be found, in some places, absent between the Drift sands and the Coralline Crag.

I should have felt much hesitation in thus offering a section so different from that given by Mr. Prestwich, in 1849*, as the result of the investigation by himself, Mr. Austen, Mr. Morris, and Mr. Tylor, but that I learn from Mr. Prestwich that he no longer adheres to the section so given. That section represented the Chillesford beds as resting unconformably on both the Red and Coralline Crag, whereas it appears to me evident that these Chillesford beds are but the continuation of the fifth or water-deposited stage of the Red Crag.

These Chillesford beds do not occur in the southern part of the Red-Crag area; the Drift sands there rest invariably on the Red Crag of either the fifth or a beach stage. The line of erosion everywhere dividing the fifth as well as the beach stages of Crag from the overlying sands, shows that these channels, after they had silted up, had become dry land; and keeping in view, therefore, the very limited thickness of these laminated

* Quart. Journ. Geol. Soc. vol. v. p. 345.

clay-beds, it is not improbable that they were formed in the small interval between the close of the fifth-stage Crag and the commencement of the deposit of the Drift sands, their sediment being furnished by the discharge of the streams to the northward, which, during the time when the Red Crag was accumulating, deposited the Fluvio-marine Crag, but which streams, at this subsequent period, under the effect of the recession at this point of the coast-line, had ceased to produce fluvio-marine conditions over this portion of the area. The base of the Drift sands, where it rests on the Red Crag, is often much mixed with loam, producing the flaky dark-red beds that immediately rest upon the eroded Crag, and furnishing, where the denudation has reached down to them, very rich lands. It appears, therefore, to me that in these we may have the equivalents of at least the laminated clays forming the upper portion of the Chillesford beds.

Crossing the ridge of Coralline Crag never covered by Red, we reach, at Thorpe, two miles north of Aldbro', the true Fluvio-marine or Norwich Crag. So far as I could learn, this solitary pit at Thorpe constitutes the only exposure of Fluvio-marine Crag south of Southwold Cliffs, a distance of eight miles further north. This exposure seems to be due to a fault bringing up the Fluvio-marine beds at this point through the overlying Drift sands which form the surrounding country*. The pit is now nearly overgrown with grass; but the beds appear to have been brought to the surface and denuded at the period of the formation of the valley-system; so that there are no means afforded of testing their position relatively to the Chillesford beds. The upper part of these Chillesford beds, composed of the laminated grey clays, occurs at a brick-field between Thorpe and Aldbro',—at which place they are pierced in the well down to a Crag which the workmen described as the yellow Coralline Crag of the pit just below, about a furlong distant, and nearer Aldbro'. The latter pit occurs at a lower level than the brick-field, and is composed of Coralline Crag; but the valley-denudation has swept the top of the pit clear of all the overlying Drift sands and of everything that may have occupied the interval between it and these sands, with the exception of two or three very minute traces of a Crag that resembles the Red, but which is so comminuted as to be incapable of identification;

* There is evidence of considerable displacement between Thorpe flag-staff and Sizewell Gap; and at the latter place the displacement has been great enough to bring down the upper Drift, that is otherwise quite denuded over this area, by a sharp pitch into the midst of the lower-Drift sands. (See Section B.) A pit there shows it inclined at a considerable angle, resting on the lower Drift.

with those traces, however, is preserved more perfectly a band of phosphatic nodules that I felt no hesitation in identifying with the basement band of the fifth-stage Red Crag. I entertain no doubt that this trace of Crag does not belong to any of the beach stages; and the only question that presents itself to me is whether it may be a remnant of the base of the Fluvio-marine Crag: that Crag, being water-deposited, may, like the Coralline, have in places under it these nodules. The means of ascertaining to which of these two this trace of Crag belongs could only be afforded by an excavation in the Aldbro' brick-field. In colour the Thorpe beds do not at all resemble this trace of Crag, which is ferruginous; and the impression I entertain is strong that the two are distinct. There can be little doubt that this Crag with the nodule-band underlies the clays forming the brick-field higher up the rise; and in that respect their relative positions agree with those we find on the opposite side of the Coralline-Crag ridge, where fifth-stage Crag passes at Chillesford up into these beds without interruption.

The conclusion that I have formed from these observations is that the Fluvio-marine Crag of Thorpe is inferior to the fifth-stage Red Crag, and as old therefore, at least, as the uppermost beach stage. It must be admitted that the evidence for such a conclusion is very incomplete and unsatisfactory; but the general consideration of the geographical conditions of the period furnish, to my mind, a support to the inference I have drawn. There can be little doubt that the fifth-stage Crag was introduced by a slight depression. That depression would enable it to cover, although very thinly and feebly, portions of the Coralline Crag never covered by the beach stages. Since this faint trace of Crag at Aldbro' immediately underlies the laminated clays, it must (if not the Fluvio-marine itself) be newer than the Fluvio-marine Crag; or else the latter is newer than the laminated clays, in which case we ought to find it overlying the clays; but such is not the case—the clays passing, without a break, up into the sands of the Drift. If, on the other hand, it be identical with the trace of Crag at Aldbro' underlying the clays, it must be at least as old as the fifth-stage Crag, that underlies and passes up into those clays. I can therefore come to no other conclusion than that the Fluvio-marine Crag is as old as the Red Crag, and most probably older than that part of it represented by the fifth-stage or water-deposited Crag.

The descriptions with which we have been furnished by Messrs. Woodward and Gunn, and by Sir Charles Lyell, of the beds occurring along the coast northwards from Southwold, have not been of such nature as to afford any satisfactory comparison with the formations I have been discussing. Nothing less than

a close survey of the area would afford the means of testing how far their horizons accord; the grouping, however, of the Drift sands and gravels which, as I have to show in the case of Suffolk and Essex, succeeded the Red Crag, goes to prove that there was a gradual and continuous recession of the coast-line during the period succeeding the Red Crag; so that, by the incoming of the great northern Clay Drift, that coast had reached the western side of those counties. This and other circumstances not within the compass of this paper lead me to a belief that some of the deposits of the north-east of Norfolk belong to an horizon at least as old as the lowest beach stage of the Red Crag. The view that I take of the direction of the coast-line prevailing during the Red-Crag period is indicated by the easternmost dotted line on the small map annexed to this paper.

The formation into which the Chillesford beds pass, and which overlies in common those beds, the fifth stage, and the beach stages of Red Crag, is one occupying a large area; and in that respect, and in the thickness of its beds, it occupies a far more important position than do any of the beds I have been discussing. From its distinct character, both in the material composing it and in the limited and definitely marked spread of the deposit, as well as in the entirely different geographical conditions under which it was formed, it appears desirable to distinguish this deposit from the great overlying Clay drift which has already received the designation of the Boulder or Northern Clay Drift. I propose therefore to call it the Lower Drift of the Eastern Counties. This formation is composed, over the Red-Crag district, almost exclusively of sands which at the bottom are loamy and rich and highly ferruginous, but gradually become more siliceous in their upper parts. Although where the valleys cut through the deposit down to its lower beds and the Red Crag rich lands occur, yet the upper or siliceous beds exposed as tablelands over large tracts form the barren heaths or sheep-walks of Eastern Suffolk. These beds distinctly pass under the Boulder-clay wherever the denudation has not removed the latter; every river-valley of East Suffolk and North-east Essex affords the means of testing this, as the whole of the more seaward extremities of these valleys have been cut through this formation, leaving the upper or Clay Drift as cappings on the higher grounds, the mixed soils of these counties being formed by the overlying clays where denuded down to a crust thin enough to mix with the underlying sands. These sands gradually change to gravels as the formation extends southwards, while they, after passing under the Clay or upper Drift, reappear on the western sides of Suffolk and Norfolk, forming the very extensive sand-tracts around Brandon. There

they repose on the Chalk, while in the south-eastern area they repose, in the condition of gravels, on the London Clay. The southern boundary of this formation may be indicated in some parts with such precision that it can with certainty be averred that this was the shore in this direction of the bay of the period. Along the coast south of the Stour, the denudation has in many places removed this formation, leaving the London Clay to form the coast-line—the lower Drift appearing a few miles inland, and furnishing outliers occasionally nearer the coast. Ranging south as far as Chelmsford, its southern edge may be traced crossing the railway-cutting a few furlongs south of Chelmsford Station, from which place it extends eastward to Danbury Hill, where it forms an outlier, apparently nearly 100 feet in thickness, resting on London Clay. Between those two points it occurs at the villages of Badow and Sandon. West of Chelmsford, it passes by Writtle, and, a mile north-west of that place, is lost under the Boulder-clay, a deep section being exposed at that place about a furlong only from its disappearance under the overlying Clay Drift. From that point to Badow, the margin of the bay depositing the beds may be indicated with certainty; but east of Badow its boundary-line has been destroyed by the great denudation that has removed the Bagshot gravels and the upper beds of the London Clay. The precise margin alluded to is shown in this way. At intervals over Southern Essex, the Bagshot sands and gravels, that originally extended, for a thickness of about 50 feet, continuously over the London Clay, now remain as outliers on the summits of the higher hills, as at Raleigh, Galleywood, Langdon, Stock, Margaretting, Warley, Shenfield, South Weald, Epping Forest, &c., uncovered by any Drift-beds, the upper or Clay Drift having been removed from them, while the tablelands that range from Brentwood towards Epping on the one hand, and towards Ongar and the Rothings on the other, are capped by these Bagshot beds, covered with patches of the upper or Clay Drift, without the faintest trace of anything resembling the lower-Drift deposit between them.

These Bagshot beds possess so uniform a character, both in their constituent material and thickness, and are so evenly and uniformly covered by the Drift clay in immediate contact with them, where that remains undenuded, that the idea of any extension of the lower Drift over this area, during the interval between the two formations, is precluded. In addition to this, the lower Drift, wherever it occurs, has invariably eroded the whole of the Bagshot beds, so that it rests on the London Clay only. This process is conspicuous near Chelmsford: there the Drift gravels may be seen resting on the London Clay, while, within the distance of a mile, the complete beds of the Bagshot

series* cap Galleywood Common, the valley of the Chelmer having been cut through the line of contact. The same feature may be perceived all along this line between Badow and Writtle; and in Section C (Pl. XVII.), I have shown the original position of the beds of the lower Drift at their southern extremity, and the mode in which the valleys have been cut through the district. Considerable alterations of the relative levels have taken place here, as over all the rest of East Anglia, by the formation of the valley-system, so that the Danbury outlier is forced up far above the corresponding level of the old shore of the bay which may be represented by Galleywood, now much below the level of the lower Drift of Danbury. The section, however, is drawn without reference to any of these changes of level, in order that the position originally occupied by the lower-Drift beds may be better shown.

It is thus very obvious how the bay depositing this lower Drift advanced inland by erosion as much as or more than by depression. Several examples of this advance by erosion occur. A very interesting one is afforded by the section on the summit of the Chalk inlier forced up at Claydon in Suffolk (see the sketch below the map): this section marks a stage when the bay had advanced but a short distance inland from the Red-Crag bay. Another example is afforded by the well-sinking at Hasketon, near Woodbridge. The base of the London Clay is brought up at Kyson, and the clay at that place has a thickness of only some 50 feet between its base and the overlying Crag; but at Hasketon a well-sinking for 120 feet failed to pierce the London Clay, and was abandoned, while at a short distance on one side of this sinking, at a few feet higher level, the lower Drift was pierced for 60 feet; and on the other side of the London-Clay boring, both upper and lower Drift have been pierced for the usual thickness of the district. Moreover, on a third side, the upper or Clay Drift rests on this London Clay, and the valley has been cut through both

* In the Sections attached to the paper of Mr. Prestwich on the correlation of the English and Belgian lower tertiaries (Quart. Journ. Geol. Soc. vol. xi. p. 241), the middle and part of the lower Bagshot are represented as denuded from Langdon Hill. Whether the Essex beds represent the middle as well as the lower Bagshot, or the lower only, they at any rate are nearly complete on Langdon Hill. The Essex Bagshot consists of about 30 feet of sand and 20 feet of pebble-beds overlying the sand, and on these pebble-beds the boulder-clay, where not denuded, rests. It is the nearly complete preservation of these uppermost pebble-beds, on the various outliers where the Drift clay has been denuded, that shows that the lower Drift never extended over them; the Bagshot pebble-beds may be traced complete along the outliers until they pass under the Drift clay. Nothing of the Bagshot series, beyond this sand and overlying pebble-bed, was ever deposited in Essex.

clays. These variations occur within a radius of about a quarter of a mile from the London-Clay boring, showing that during the progress of the lower Drift the sea had eroded and encompassed an island of London Clay, by the sides of which it deposited its sands, but the top of which was never covered by that sea, but was overflowed when the great depression brought in the upper Drift. The lower Drift is cut through by the railway from London to Yarmouth, without any break, from the point where it is lost under the upper Drift near the Norfolk boundary of Suffolk to its termination at Chelmsford; and the railway-cuttings afford a continuous section, and show the sands that occupy the Crag-area and the country to the northward gradually changing into gravels as the more southern portions of the deposit are cut through.

I have indicated on the small map the outcrop of this formation from beneath the overlying Clay Drift along the eastern side of it; but the western outcrop I have not ventured to delineate, as it is some years since I visited the extensive development of the deposit around Brandon. The junction-line connecting the western side of that development of the deposit with the emergence of the deposit from beneath the Clay at Writtle (and forming between those places the western boundary of the formation), being hidden by the overlying Clay Drift, is only to be ascertained accurately by the well-borings: these I have not yet been able to collect, but I have indicated on the map what may be taken as an approximation to that line. North and west of Brandon, the lower Drift has undergone a denudation along the fen-border; and I have not had the means yet of testing precisely where the boundary-line of the deposit, shown by the upper Drift resting on the Secondaries, as in Lincolnshire and Bedfordshire, without the occurrence between them of any lower Drift, is to be drawn.

The thickness of the lower-Drift beds appears very uniform: the well-sinkings above Woodbridge give from 60 to 70 feet. Nearly the entire deposit is exposed at the scarp by Wilford Bridge over the Deben, near Woodbridge, the Crag occurring about 5 feet below the pit, and the upper or coarse gravel-beds remaining undenuded; the thickness there is between 60 and 70 feet. Danbury seems to show a greater thickness, but there perhaps something may be deducted on account of a slight bending of the beds over the hill.

The transition from the lower to the upper or Clay Drift, although most abrupt, is unmarked by the slightest evidence of violence; the sands and gravels give place to the clay sharply, passing, by a very thin band of loam, into each other. Sections showing the passage are not so common as might, from the

structure of the county, be expected; good sections, however, showing the passage may be found in the pit behind Sizewell Gap already alluded to, in a pit a mile west of Leiston, on the Saxmundham road, and in a pit at Hoo, a mile on the Charsfield side of the bridge over the Deben. Over Suffolk, the upper part of the lower Drift is marked by beds of coarse gravel, the stones being large and angular, and sparsely scattered in the sand: they are unlike the gravels that occasionally, even in this area, occur near the base of the deposit, the latter being more rounded and thicker-bedded, while the former have the character of being ice-borne, and much resemble the small boulders occurring in the Drift clay. The characteristic pebble of the lower-Drift beds is a pink quartzite, which I have identified more nearly with a quartzite from Freyburg than with any other. It is probable that the lower-Drift bay, of which only the lower and western border touched England, extended across the north of Europe to a great distance in the direction of Germany, and that the gravels accumulated in it were largely supplied with detritus carried from that country along the southern shore of the bay. The depression that introduced the upper Drift seems to have been both sudden and uniform; and if the view be well founded which I have taken as to the formation of the valley-system* of Eastern England—that all the inequalities of surface now existing there are of an origin later than the Drift—we may conceive that a sudden, though moderate, depression would at that time have submerged the very extensive area occupied by the Jurassic, Cretaceous, and Tertiary strata: the materials of these, and particularly the two former, it is well known, have largely contributed to the upper Drift, the supply of which appears to have been chiefly furnished from the British strata. The thickness of this upper Drift over Suffolk and Essex does not, where least denuded, exceed the maximum thickness of the lower Drift; and its deposition seems to have ceased before the spreading of the great erratics of the northern counties commenced. At any rate, the great erratics are generally absent over the southern part of the eastern counties; and as no denudation could well have removed them, but must have allowed them to sink upon the uncovered beds, we may assume that the causes giving rise to the erratic distribution of northern England did not exist over these more southern counties. Probably before the high lands of the northern part of England were submerged, the great plain then formed by the strata newer than the Trias had sunk to a depth beneath the sea too great to arrest icebergs on their transit, if these were the means of spreading the erratics; on the other hand, the greater distance of these counties from

* Phil. Mag. ser. 4. vol. xxvii. p. 180.

the high lands of the north of England would exempt them from any part that glaciers may have played in the distribution of the great boulders of that part of England.

Notwithstanding the confusion that has existed as to the relationship to the Drift borne by the freshwater formations of Grays, Ilford, Clacton, Stutton, Copford, Lexden, Hoxne, &c., I take it to be now well understood that these and similar formations in other counties are altogether posterior to the Drift period, having been deposited in the valleys that resulted from the upheaval of the bed of the upper-Drift sea, and from the denudation that accompanied such upheaval. Being limited for space, I have not referred to these beds, but confined myself to marking into the map of the Red Crag district the only deposit of this nature (that of Stutton and Wrabness) occurring within it. It will be seen that the Stutton and Wrabness beds rest on the London Clay, which previously to their deposition had been laid bare by the denudation of both Drifts, and which denudation accompanied those symmetrical movements that elevated the upper-Drift sea-bed, and gave rise to the inequalities of surface over the East of England which form the subject of my paper on the valley-system before alluded to. The other correlated freshwater deposits named above are identical with that of Stutton in their position relatively to the Drift, although they vary in the bed they rest upon, according as the denudation has in a greater or less degree eroded the valley previous to their deposit; but, within the limit of the period elapsed since the upheaval of the Drift sea-bed, these deposits may to a small extent vary in age among themselves. The greater contiguity of the Thames valley to the centres of upheaval producing the valley-system, but more particularly its greater contiguity to the great rectilinear upheavals of the Weald and South of England which succeeded the general upheaval producing the valley-system, has, as I conceive, caused in that valley greater changes of level among its deposits than is the case with the beds accumulated in the valleys of the rivers of northern Essex. The precise correlation in age of the valley-deposits of the respective areas is therefore, I think, to be satisfactorily arrived at rather by close palæontological analysis than by comparisons of level and physical structure.

APPENDIX.

Sections of Red Crag.

ALDERTON. On the Ramsholt road, three-quarters of a mile from Alderton.—Fifth stage, laminated with red sands, and false-bedded. No line of erosion visible. Traces of a beach stage at bottom. Nodule-band occurs.

BAWDSEY. Sea-cliff.—Fifth stage. Fourth and two other beach stages.

Nodule-band visible high up in the cliff. (See woodcut of fourth stage.)

BEALINGS (LITTLE). Pit in a shrubbery of the residence of — Colvin, Esq.—Fourth and fifth stages.

BENTLEY. Pit 100 yards from railway station.—Fifth stage. Nodule-band and two beach stages. Deep line of erosion between fifth stage and sand.

BUCKLESHAM. Pit south of Rectory.—Two feet of fifth stage, with strong line of erosion between it and the sand.

Pit north-east of Rectory.—Fourth and fifth stages; line of erosion between the latter and the sand.

Another pit in adjoining field, with the beds much shattered.

BUTLEY. Near the Oyster Inn.—Two stages visible.

Another pit near the mill.—Three stages visible.

Several large pits five furlongs south-west of church, containing three beach stages, the lowermost exhibiting traces of being not true beach, but formed in shallow water.

CHILLESFORD. Below the church.—Fifth stage and a beach stage.

FOXHALL. Pit near to and east of Foxhall Hall.—Fourth and fifth stages.

Nodule-working on hill 300 yards south of last pit.—All fifth-stage Crag resting on London Clay, and overlain by red sands.

Another working, a quarter of a mile south of last pit, and five furlongs north-west of Bucklesham.—Similar to last section.

HOLLESLEY. A farm-yard nine furlongs south-west of church, beside road to Shottisham.—Fifth stage and four beach stages. (See woodcut.)

Pit 300 yards east of the last.—Fifth stage; only faint line of erosion between it and the sand.

Pit 200 yards south-east of church.—Two beach stages.

Pit close to and immediately north of church.—Fourth stage composed of sands and gravels only, the planes dipping N.N.E. to S.S.W. No shells.

Pit a quarter of a mile north-north-west of church.—Similar to last pit.

Pit beside farm-house, three quarters of a mile north-north-west of church.—Fifth stage only, brought up through the sand by a fault.

IPSWICH. Side of road leading from Goldroods down to Belstead Bridge.—Fourth stage.

LEVINGTON. Half a mile east of church.—Fifth stage. Line of erosion visible.

Immediately south of church, on opposite side of road, a small section of fifth stage.

MELTON. Pit on by-road five furlongs south-west of church.—Fourth and lower beach stages. (See woodcut.)

NACTON. Nodule-working north side of road to Levington, and midway between each place.—Fifth stage, resting on London Clay.

NEWBURN. A quarter of a mile north by east of Bucklesham mill.—Fourth stage, dipping N.N.E. to S.S.W. Composed of sand only.

A quarter of a mile north-east of church.—Fourth stage. A thickness of 20 feet of beach is here exposed.

RAMSHOLT. Bluffs by the Dock Inn.—A beach stage overlain by fifth stage: faint line of erosion between the latter and the sand. The beach-stage laminae here have an inclination of nearly 45°.

Pit a quarter of a mile west-north-west of church.—Beach stage overlain by fifth stage. Nodule-band between them.

A nodule-working 50 yards south of the last.—Fifth stage, resting on the Clay.

The cliff between Shottisham Creek and Church-farm.—The fifth stage is visible; but the beach stages are probably obscured by the talus. The Coralline Crag occurs here at the base of the cliff.

SUDBOURN. Pit half a mile north of the village, corner of Tunstall Heath.—Beach stage only.

Two pits are given by Mr. Prestwich (Quart. Journ. Geol. Soc. vol. v. p. 352) of Red Crag on Coralline, north-north-east of Sudbourn Church; but I could not find them. There is probably some clerical error in the directions.

SHOTTISHAM. Nodule-working a quarter of a mile north of Shottisham Hall.—Fifth stage resting on London Clay.

Another pit, nearer to Shottisham Hall.—Fifth-stage, Crag exposed.

SUTTON. Watercourse half a mile east of Methersgate Dock, on the Deben.—Three beach stages and fifth stage. Nodule-band between the latter and beach stage.

South-east of the last are extensive abandoned nodule-workings; and

Still further east, leaving the workings, fifth stage appears over beach stages, with nodule-band between them.

Nodule-working 150 yards west of Sutton Hall.—A very large section of fifth stage resting on London Clay.

Pit opposite the Meeting-house at Brockstead.—Four beach stages are visible, overlain at one corner only by fifth stage.

Pit half a mile south of Pettistree-Hall.—Fifth stage much washed up on the surface. Two Coralline-Crag pits occur to the north-east of it.

TRIMLEY. Four pits occur here, from half to three-quarters of a mile north-east of the churches. Two of them have fourth stage overlain by fifth-stage Crag. Another contains fourth stage only (no shells); and the other contains fourth stage and an underlying beach-stage.

TATTINGSTONE. Pit five furlongs north-north-west of church.—Fifth stage, with nodule-band overlying two beach stages.

Pit close to Tattingsstone Hall farm.—Fifth stage underlain by nodule-band and two beach stages. The Coralline Crag occurs here; but the beds have been broken and shifted by faults.

Pit behind Crag Hall.—Three beach stages. (See woodcut, page 188.)

WALTON NAZE. Sea-cliff.—A brown Crag, full of water, rests on the Clay containing shells preserved as they died, overlain by two beach stages and by fifth stage.

The Coralline-Crag pits not mentioned above are all at Sudbourn, Iken, Orford, and Aldbro'. They are mostly enumerated by Mr. Prestwich in Quart. Journ. Geol. Soc. vol. v. p. 352.

The sections of Chillesford beds are also given by him in the same list; but, in addition to them, the following sections of these beds may be found by reference to the Ordnance Map:—

Pit 200 yards north of road from Chillesford to Sudbourn, three quarters of a mile east of the brick-field.

Pit by Iken Church.

Ditto half a mile south-west of Calton farm.

Brick-kiln one mile north-north-west of Aldbro'.

N.B. Coralline Crag has also been found in digging at Trimley (authority of the late Mr. Acton).

XXI.—On the Occurrence of *Amæbiform Protoplasm*, and the Emission of *Pseudopodia*, among the Hydroids. By Professor ALLMAN, F.R.S.

[Plate XIV.]

ONE of the most striking peculiarities of the hydroids which compose the family of the *Plumulariade* is the occurrence among all of them of certain singular bodies which are produced as buds at definite spots upon the hydrosoma. These bodies have been examined by Huxley* and also by Busk, who, from the fact of their often containing clusters of large thread-cells, has named them "nematophores"†.

The most important character, however, of the nematophores has hitherto escaped notice; and yet it is one full of interest, involving as it does the manifestation of phenomena whose existence among the *Hydroids* has not as yet been suspected.

The species which I have had an opportunity of most thoroughly examining are *Aglaophænia pluma* (*Plumularia cristata* of most authors) and *Antennularia antennina*; and I shall confine the present paper to a description of the nematophores and their contents in these two hydroids.

1. *Aglaophænia pluma*.

In *Aglaophænia pluma* there are two sets of nematophores—a mesial and a lateral (Pl. XIV. figs. 1–4). The mesial nematophores (*a a*) are situated exactly in the mesial line, one being placed in front of every hydrotheca. These mesial nematophores consist each of a chitinous tube with peculiar contents. The tube springs from the base of the hydrotheca, and, thence continuing for the greater part of its length adnate to the front of the hydrotheca, terminates in a free tubular spine-like process a little below the orifice of the latter. It opens below into the common tube of the chitinous periderm; and just before its termination its cavity communicates by a lateral orifice with that of the hydrotheca, while its free end opens externally by a very oblique aperture.

* Huxley, "On the Anatomy and Affinities of the Medusæ," Phil. Trans. 1849, p. 427.

† Busk, Hunterian Lectures (MS.), delivered at the Royal College of Surgeons, London, 1857.

The lateral nematophores (*b*) consist, like the mesial ones, of tubular processes from the chitinous periderm, and of peculiar contents; but while the mesial nematophores are formed by a set of azygous appendages, the lateral ones are, on the other hand, arranged in pairs, each pair consisting of two processes, which are given off, exactly opposite to one another, from the sides of the branch, nearly on a level with the orifice of every hydrotheca. The chitinous tubes communicate at their base with the cavity of the tubular periderm of the branch, and open by an oblique aperture at their free extremity.

The contents of the nematophores consist, in both cases, of a soft granular mass, which is continuous below with the ectoderm of the coenosarc, and, just behind the terminal aperture, ends in a bulbous extremity (*c*), in which is immersed a cluster of large fusiform thread-cells.

In those nematophores which lie along the mesial line, the tubular sheath is furnished, as has just been said, not only with a terminal aperture, but also with a lateral one, through which its cavity communicates with that of the hydrotheca. Through this aperture the soft granular mass which fills the tube of the nematophore has the power of emitting very extensile and mutable processes, which project into the cavity of the hydrotheca. These processes (*d*) consist of a finely granular substance, which undergoes perpetual change of form, being at one time broad lobe-like extensions, at another longer and more cylindrical, sometimes more or less clavate, occasionally irregularly branched; while, again, they can be entirely withdrawn (*d*), so as to leave no apparent trace of their existence. In short, they comport themselves in every respect exactly like the "pseudopodia" of an *Amœba*, which they also resemble in their structure; for they consist of a simple protoplasm composed of a transparent semi-fluid basis, in which minute corpuscles are suspended.

Those nematophores which, instead of being situated on the mesial line, are arranged along each side of the branch, have their contents quite similar to the others, and send out from their terminal aperture similar pseudopodial processes (*e*), which are then projected freely into the surrounding water. I have never witnessed the emission of pseudopodia from the terminal apertures of the mesial nematophores. In no case do the thread-cells appear to be carried out in the pseudopodia.

It would thus seem that the contents of the nematophores in *Aglaophenia pluma* consist of a true sarcode or protoplasm; and, except in the fact that this protoplasm contains a cluster of thread-cells immersed in its substance, it appears in no respect to differ from that which constitutes the substance of an *Amœba*.

2. *Antennularia antennina*.

In *Antennularia*, a genus possessing the closest affinities with *Plumularia*, phenomena entirely similar to those just described in *Aglaophænia* may be witnessed.

In *Antennularia antennina* (Pl. XIV. fig. 5), a pair of conical cup-shaped nematophores (*b*) spring from the hydrosoma on a level with the mouth of every hydrotheca; while between every two hydrothecæ there also occur three similar, but azygous, nematophores (*a*), which are arranged mesially along the front of the ramulus. The nematophores of *Antennularia* differ from those of *Aglaophænia* in the fact of their being each attached to the hydrosoma only by their narrow extremity, while from this point they are free for their entire length. They terminate at their distal or wide extremity in a hemispherical cup-like depression, whose bottom is formed by a chitinous membrane constituting a diaphragm which separates the cavity of the cup from that of the rest of the nematophore. This diaphragm, however, is perforated by a circular aperture in its centre. The nematophore is thus bi-thalamic, consisting of two chambers—a proximal deeper and narrower one, and a distal wider and shallower one, the two freely communicating through the perforation in the dividing diaphragm.

The whole nematophore is filled with a granular protoplasm, which is continued from one chamber into the other through the perforated diaphragm. In the distal chamber, it forms, when in a state of repose, a little spherical mass (*d*); but there does not occur in the nematophores of *Antennularia* any special accumulation of large thread-cells, as in those of *Aglaophænia pluma*, and only a few minute thread-cells may be seen scattered through the protoplasm.

When a living branch of *Antennularia antennina* is examined in a trough of sea-water under the microscope, the mass of protoplasm which occupies the distal chamber may be seen, in both sets of nematophores, to slowly elongate itself into a variously shaped process (*d'*, *e*), exactly like the pseudopodium of an *Amæba*. When this process meets the external surface of the ramulus, it frequently runs in contact with it for some distance, and, while we continue to look, the whole will be again slowly withdrawn, until it once more assumes the form of a spherical mass filling the cup-like distal chamber of the nematophore. The pseudopodial processes of the nematophores in *Antennularia antennina* are usually simple; in one instance only did I witness what seemed to be a short irregular branch given off from the finger-like pseudopodium.

EXPLANATION OF PLATE XIV.

Figs. 1-4. Hydrotheca with polypite and neighbouring parts in *Aglaophænia*

pluma. Fig. 1 exhibits the polypite exerted from the hydrotheca, and the pseudopodia withdrawn: *a a*, mesial nematophore; *b*, lateral nematophore; *c*, bulbous termination of the protoplasmic contents of mesial nematophore, with a cluster of large thread-cells immersed in the protoplasm; *d*, point at which the protoplasm of the mesial nematophore may be projected in the form of a pseudopodium through the lateral aperture of the nematophore into the cavity of the hydrotheca. The figure represents the condition in which the pseudopodial process is entirely withdrawn.

Figs. 2-4. Polypite retracted and the pseudopodia in various states of emission: *d'*, pseudopodia projected into the cavity of the hydrotheca through the lateral aperture in the mesial nematophore. In fig. 4, the pseudopodium has become irregularly branched: *e*, pseudopodia projected into the surrounding water from the summit of the lateral nematophore.

Fig. 5. Portion of a ramulus of *Antennularia antennina* with hydrotheca and exerted polypite, and nematophores: *a*, azygous or mesial nematophores; *b*, lateral nematophores in pairs; *d*, protoplasm in a state of repose, forming a spherical mass in the distal chamber of the nematophore; *d'*, protoplasm of the azygous nematophores extended as a digitiform pseudopodium; *e*, similar extension of the protoplasm of the lateral nematophores.

XXII.—On the Species of *Neæra* found in the Seas of Japan.

By ARTHUR ADAMS, F.L.S. &c.

THE species of *Neæra*, properly so called, are less numerous than is commonly imagined. Many shells formerly regarded as belonging to this genus have already been distributed among other tribes. For example, *N. viridescens*, Hinds, *N. opalina*, Hds., and *N. lata*, Hds., have been properly referred to *Theora*, a genus which I consider should be placed in Tellinidæ, in close proximity to *Abra* or *Syndosmya*. Then, again, *N. lyrata*, Hds., *N. tenuis*, Hds. and *N. pulchella*, Ad. & Rve., have been removed to *Raëta*, a genus of Mactridæ; and now I shall endeavour to show, by an examination of the hinge-teeth and by other characters, that *N. cochlearis*, Hds., and *N. adunca*, Gould, constitute two small groups in the immediate vicinity of *Scrobicularia*.

The genus even then, when properly restricted, will exhibit forms so dissimilar, or dentition so peculiar, as to require to be thrown into three distinct groups.

Genus *NEÆRA*, Gray.

Shell inequivalve. Surface of valves lamellar. Hinge with a prominent cup-like cartilage-pit. Right valve with a posterior lateral tooth.

1. *Neæra elegans*, Hinds.

N. elegans, Hds. Proc. Zool. Soc. 1843, p. 76.

N. Moluccana, Ad. & Rve. Moll. Voy. Sam. pl. 23. f. 4.

Hab. Mino-Sima; 68 fathoms.

2. *Neæra nobilis*, A. Ad.

N. testa oblonga, ventricosa, albida, antice rotundata, postice valde rostrata, concentrice plicata; plicis salientibus, subconfertis, æquidistantibus, interstitiis concentricis striatis; rostro angulato, recurvato, ad apicem rotundato; margine ventrali arcuato, simplici.
Lat. 1 unc. 7 lin., alt. 1 unc.

Hab. Mino-Sima; 63 fathoms: Quelpart; 52 fathoms.

A fine species, most nearly resembling *N. rostrata*, Chemn., or *N. Chinensis*, Gray. The outline of the shell, however, is very different, the beak being broad and triangular, and the surface of the valves concentrically plicate.

3. *Neæra Hindsiana*, A. Ad.

N. testa oblonga, ventricosa, albida, antice rotundata, postice rostrata, concentrice lamellata; lamellis pliciformibus, regularibus, subdistantibus, interstitiis concentricis striatis; rostro angulato, attenuato, corrugato, recurvato.
Lat. 10 lin., alt. 5 lin.

Hab. Gotto; 48 fathoms.

The form of this species is very similar to *N. elegans*, Hds.; but the lamellæ of the valves are regularly concentric, the shell is more elongate at the sides, and the beak is shorter and more recurved.

4. *Neæra nasuta*, A. Ad.

N. testa oblonga, obliqua, ventricosa, albida, antice rotundata, postice longirostrata, concentrice striata, striis confertis irregularibus; rostro elongato, attenuato, deflexo, corrugato; margine ventrali valde arcuato.
Lat. 11 lin., alt. 6 lin.

Hab. Satanomosaki; 55 fathoms.

A ventricose oblique species, with the valves concentrically striated, and the slender elongate beak bent downwards, giving to the shell a very peculiar spoon-like appearance.

Subgenus RHINOMYA, A. Ad.

Surface of valves lamellar. Hinge with a small triangular cartilage-pit and two lateral teeth in right valve.

1. *Rhinomya Philippinensis*, Hinds.

Neæra Philippinensis, Hds. Proc. Zool. Soc. 1843, p. 78.

Hab. Kino-O-Sima; 25 fathoms: Uruga; 21 fathoms.

2. *Rhinomya rugata*, A. Ad.

R. testa oblonga, ventricosula, albida, concentricis confertim lirata;

liris corrugatis, subincrassatis; antice rotundata, postice rostrata; rostro elongato, attenuato, apice truncato.

Lat. 4 lin., alt. $2\frac{1}{4}$ lin.

Hab. Tabu-Sima; 25 fathoms.

A small species, very much resembling in form *N. Philippiensis*, Hds., but with the surface of the valves concentrically rugosely striate.

Subgenus *CARDIOMYA*, A. Ad.

Shell inequivalve. Surface of the valves radiately ribbed. Right valve with a prominent posterior lateral tooth.

Cardiomya Gouldiana, Hinds.

Neæra Gouldiana, Hds. Proc. Zool. Soc. 1843, p. 77.

Hab. Uruga, 21 fathoms; Gotto, 48 fathoms; Tsu-Sima, 25 fathoms.

Genus *LEPTOMYA*, A. Ad.

Shell thin, ventricose, beaked posteriorly. Surface of valves lamellar. Hinge with an oblique cartilage-pit in each valve. Right valve with two anterior primary teeth; left valve with a single primary tooth. Lateral teeth none. Pallial sinus deep.

This genus belongs to the family Tellinidæ; and is closely allied to *Scrobicularia*.

1. *Leptomya cochlearis*, Hinds.

Neæra cochlearis, Hds. Proc. Zool. Soc. 1844, p. 98.

Hab. Gotto; 48 fathoms: Seto-Uchi; 7 fathoms.

2. *Leptomya adunca*, Gould.

Scrobicularia (Capsa) adunca, Gld. Otia Conch. p. 167.

Hab. Tsu-Sima; 30 fathoms.

Subgenus *LEIOMYA*, A. Ad.

Shell thin, ventricose, hyaline, beaked posteriorly. Hinge with an internal cartilage-pit in each valve. Right valve with two anterior primary teeth; left valve with a single primary tooth. Lateral teeth two, strong, prominent.

Leiomya adunca, Gould.

Neæra adunca, Gld. Otia Conch. p. 162.

Hab. Seto-Uchi; 7 fathoms: Hakodadi, 7 fathoms.

Genus *THEORA*, H. & A. Ad.

Shell thin, smooth, pellucid, gaping at both sides. Hinge

with an oblique cartilage-pit in each valve; primary teeth noné. Valves simple within.

The deep sinus of the pallial line, together with the form of the valves and the pellucid vitreous texture of the shell, clearly show that this genus belongs to the Scrobiculariate division of the Tellinidæ, and not very far from the *Abra* of Leach or *Syndosmya* of Récluz.

1. *Theora iridescens*, Hinds.

Neæra iridescens, Hds. Proc. Zool. Soc. 1843, p. 78.

Hab. Yobuko.

2. *Theora fragilis*, A. Ad.

Neæra fragilis, A. Ad. Proc. Zool. Soc. 1855, p. 226.

Hab. Niegata; 7 fathoms.

3. *Theora nitida*, Gould.

Theora nitida, Gld. Otia Conch. p. 162.

Hab. Seto-Uchi: Simonoseki; 7 fathoms.

Subgenus ENDOPLEURA, A. Ad.

Shell pellucid, gaping at both sides. Hinge with a bifid primary tooth in front of the oblique cartilage-pit. Valves with an internal rib extending from the beaks obliquely towards the anterior side.

Endopleura lubrica, Gould.

Theora lubrica, Gld. Otia Conch. p.

Hab. Hakodadi; 10 fathoms: Niegata, 7 fathoms.

XXIII.—*Characters of new Land-Shells from the Mahabaleshwar Hills in Western India, and from Agra in the North-west Provinces.* By W. H. BENSON, Esq.

Achatina Arthuri, B.

A. testa ovato-conica, irregulariter plicato-striata, luteo-fulva, polita, translucente; spira ovato-conica, apice obtuso, sutura impressa; anfractibus $7\frac{1}{2}$, convexiusculis, prope suturam subcrenulatis; apertura subverticali, elliptico-ovata; peristomate crassiusculo, callo parietali infra albedo; margine columellari oblique truncato.

Long. 19, diam. 10, apert. long. 8 mill.

Habitat ad Neher (Malcolm Peth) montibus Mahabaleshwar dictis.

A single specimen, in a state too imperfect for description, was taken by my son, Lieut. Arthur E. Benson, then in the 10th Hussars, at the hill-station in question, in 1853. I sent a rough sketch to the Rev. S. B. Fairbank, who searched carefully for it, and has kindly furnished me with three living spe-

cimens, one of which exhibits the large dimensions recorded above.

Helix Neherensis, B.

H. testa anguste et perspective umbilicata, depressa, lenticulari, oblique striatula, lineis concentricis vix impressis, confertissimis, superne et infra decussata; spira convexuscula, apice planato, sutura marginata subcanaliculata; anfractibus 5, convexusculis, ultimo ad peripheriam rotundato, subtus convexo, circa umbilicum excavato; apertura obliqua, late lunata; peristomate tenui, recto, marginibus callo tenui minutissime granulato junctis; columellari subverticali, brevi, reflexiusculo.

Diam. major 5, minor 4, axis 2 mill.

Habitat ad Neher, Mahabaleshwar. Detexit S. B. Fairbank.

This peculiar little species, which I have, at the suggestion of the discoverer, named after the place where it was found, appears to have escaped the observation of Mr. W. T. Blandford, who collected several new land-shells during a hurried search at the same locality, which is noted for its abundant rainfall during the monsoon. The delicate concentric lines are visible under a lens.

Carychium Boysianum, B.

C. testa subrimata, elongato-cylindrica, sub lente oblique minutissime striatula, translucente, nitida, albida; spira elongata, gradatim attenuata, apice obtuso, sutura impressa; anfractibus 5, convexusculis, subplanulatis; apertura subverticali, $\frac{1}{3}$ longitudinis non sequante, oblonge ovato-acuta; peristomate expanso, planulato, nonnunquam subduplici, margine dextro intus 1-tuberculato, parietali plica 1, columellari altera obliqua munitis, callo parietali expanso.

Alt. 2, diam. vix $\frac{3}{4}$ mill.

Habitat prope urbem Agra, ad ripas fluminis Jumna. Detexit Capt. W. J. Boys.

This species, discovered at the Táj, near Agra, by the late Capt. Boys, is closely allied to the Himalayan species *C. Indicum*, B., but is distinguished by its more elongated cylindrical and less rapidly attenuate form, and its flatter whorls, also by the narrower and more acute aperture, the right lip being straighter and less convex, and by the expanded parietal callus.

Mr. Fairbank sent me a rough variety of *Ancyclus Verruca*, B., of the Lower Himalaya and Rohilkhund, with the small variety of the Gangetic *Planorbis nanus*, which were taken by him in the Mahabaleshwar waters, with the shell imperfectly described by Mr. E. Layard, in the 'Proc. Zool. Soc.' for 1854, as *Anculotus carinatus*, which bears some resemblance to Mr. Anthony's North-American shell of the same name. I consider the Indian species to be a *Melania*. They were accompanied by a new

heliceform *Vertigo* and by a large *Succinea*, also taken by Mr. Blanford, who will probably describe them together with a large *Helix* allied to *H. Bajadera*, Pfr.

Cheltenham, Feb. 5, 1864.

XXIV.—Description of a *Labyrinthibranchiate* Fish from the Nile.

By Dr. ALBERT GÜNTHER.

A VERY fine collection of fishes made on the Upper Nile, at Chartoum and Gondokoro, by Consul John Petherick, contained, among other novelties, a species of *Labyrinthibranchiate* fish belonging to the genus *Ctenopoma*, Peters, species of which have hitherto been found only in Southern and Eastern Africa, where they represent the East-Indian *Anabas*.

Ctenopoma Petherici.

D. $\frac{18}{10}$, or $\frac{16}{9}$, or $\frac{15}{9}$. A. $\frac{10}{9-11}$. L. lat. 29. L. transv. $\frac{3 \text{ or } 24}{9}$.

The height of the body is one-third, or a little more than one-third, of the total length (without caudal); the maxillary extends to below, or but slightly beyond, the anterior margin of the eye. Teeth in the jaws and on the palate in narrow bands. The diameter of the eye equals the extent of the snout. Five series of scales between the orbit and the angle of the preoperculum, the outer series covering the preopercular margin. Operculum, inter-, and suboperculum strongly serrated. The soft rays of the vertical fins covered with small scales. Brownish olive; many scales with a brown central spot, these spots being less distinct in old specimens than in young ones; a round black spot, sometimes edged with whitish, on the root of the tail.

The largest specimen is $6\frac{1}{2}$ inches long.

This species is more nearly allied to *C. multispine* than to *C. microlepidotum*, but may be readily distinguished by its deeper body, by its narrower mouth, the maxillary extending to below the middle of the eye in *C. multispine*, &c.

The same collection contained examples of *Ophiocephalus obscurus*, Gthr., described from West-African specimens, and a complete series of *Clarotes*, showing that this genus has been founded by Hyrtl and Kner on a deformed specimen, and that the species has been long ago named *Pimelodus laticeps* by Rüppell, the development of the rays and of the spine of the adipous fin being dependent on age.

XXV.—*Observations on Raphides.*

By GEORGE GULLIVER, F.R.S.

[Continued from p. 121.]

Historical Notice of Raphides as Natural Characters.—All the microscopic crystals of plants have been too commonly included under the name of raphides, and true raphides have long been known in the different classes of Phanerogamia. Thus it is stated, either in our most comprehensive botanical treatises or special essays, that raphides abound in such Dicotyledones as Urticaceæ, Cactaceæ, Geraniaceæ, and the roots of Umbellifereæ, and in "Monocotyledones generally," of which Araceæ and the "sepals of Orchidaceæ" are cited as particular examples; while even Schleiden asserts that the needle-formed crystals, in bundles of from twenty to thirty in a single cell, are present in almost all plants, and that inorganic crystals are seldom met with in cells in a full state of vitality. Hence such a vague impression has arisen that raphides occur either with much frequency and irregularity, or in connexion with the decay of the plant, that the attainment of the truth becomes hopeless without a careful attention to the context in books and a more earnest appeal to the reality in nature than has yet been made. Notwithstanding the detached drawings and descriptions of raphides among pollen and other parts of some plants, from the time of the artist Bauer to the recent analysis of the raphides in the ovary of *Richardia* by MacLagan, even the fact (often shown in the course of the present observations) of the constancy and universality of raphides through the greater part of the healthy frame, from the seed-leaves and young buds to the ovule and ripe fruit, of certain species has not been recognized in our botanical treatises. No wonder, then, that the value of raphides as natural characters has never been realized, and that we find them neglected, both in the short diagnoses and longer descriptions, in the latest systematic works of such eminent botanists as Lindley, the Hookers, Balfour, Babington, and others. But it may be hoped that more general attention will soon be given to the subject; for it is so very extensive that I have been able to do little more than show its importance.

Recurring to the orders above mentioned, quoted by authors as affording raphides, if we examine such given specific examples as may be seen in the last edition of the excellent 'Micrographic Dictionary,' we shall soon learn that in the two latter orders only are true raphides shown, and sphæraphides merely in the other orders. Thus one source of ambiguity will be dispelled, while we realize a regular and characteristic difference between the plants in question, shown by those very crystals which have all been included under the same name. And we shall soon see more light by the assistance of nature.

Adopting Lord Bacon's recommendation to review our knowledge and transplant it into the minds of others as it grew in our own, it may be proper to mention here how the importance of raphides as natural characters became evident to me. During many years I have been making dissections under the microscope, and notes of the results, of every native plant collected in my country excursions. These researches were undertaken mainly for the purpose of comparing the intimate structure of plants and animals, and of learning incidentally what good diagnoses might thus be found between nearly allied orders and species. In the natural sciences, the study of difference or contrast is more difficult and scarcely less important than the study of resemblance or analogy; and the complaint of Lord Bacon (Works, 4to, vol. i. p. 68) of the comparative neglect of difference in anatomy is still applicable to modern science. Since the discoveries of Schleiden and Schwann, important advances have been made in both directions, including the valuable characters afforded by the bone-cells and intimate structure of the teeth of animals, as expounded by the late Prof. Quekett, the late Mr. Nasmyth, and Mr. Tomes. And I have long ago shown (Appendix to Gerber's Anatomy, 1842) that there are animals which may not only be distinguished by their red corpuscles alone from other species of the same order, but from those of every other order, of the vertebrate subkingdom; nay, that the most universal single diagnostic between the two chief divisions of that subkingdom is in the blood; that is to say, while a nucleus regularly exists in the red corpuscle of oviparous vertebrates, that nucleus is as regularly wanting in the red corpuscle of Mammalia: and hence the designations *Vertebrata Pyrenæmata* and *Vertebrata Apyrenæmata* (Hunterian Oration, 1863, p. 20; and College Lectures, reported in 'Med. Times,' 1862-63).

Excepting the diagnoses of a few orders as *Coniferæ*, *Orchidaceæ*, and *Onagraceæ*) by the woody tubes and pollen, we find little use made, in systematic and descriptive botany, of the distinctions afforded by intimate structure between the subdivisions of *Vasculares*. Hence the orders, genera, and species seemed to require further research, especially as regards the characters which might appear in modifications of size, form, structure, and functions of the cells, and in the properties of the juices. The latex (Annals, March 1862), hairs, pollen- and other cells were sometimes found available in this way. But these observations had not long been prosecuted before examples were often found of the truth of Schleiden's remarks as to how little hope there is, without a study of the fundamental principles of development, of much further aid to systematic botany from mere ana-

tomy and physiology. After a while, however, it was seen that anatomy would occasionally, as was exemplified in *Juncaceæ* and *Hymenophyllæ* (*Annals*, Aug., Oct., and Dec. 1868), afford good diagnoses even between allied vascular plants; and the value of such characters in mosses had long been known. It was not before a large accumulation of my notes had been examined that crystals were thought of in this point of view; for they had not even been particularly looked after, and were merely noted, whenever seen, long before their significance as characters was suspected. But when every one of those notes of raphides had been picked out, it was very unexpectedly discovered that the plants in which they occurred would sometimes come under certain orderly arrangements. Thus, not a single species belonging to the orders *Onagraceæ* and *Galiaceæ*, was without a note of raphides, while in no single instance were these acicular crystals noted in the next allied orders. And, conversely, a single order (*Hydrocharidaceæ*, for instance) in which raphides were regularly wanting would be surrounded by orders in which raphides were as constantly abounding. Then repeated experimental trials proved that raphis-bearing is an essential and intrinsic, plain and characteristic phenomenon throughout the life of certain species. Accordingly the conviction arose that such observations, among the infinite details of Nature, might add to our knowledge of the affinities and contrasts of some plants and of their true position in her system. So the inquiry was further pursued, with the results already given in these communications, and to be continued in others awaiting publication. Among the most remarkable of these results is the fact, that whenever raphides afford a diagnostic between two plants, it will be so much more fundamental and universal than any other single character yet in use, that mere fragments of those plants, at any period of their growth, may be sufficient to show the difference. And in this sense only have these epithets been used by me in relation to this subject.

Orchidaceæ.—We have already seen raphides abounding generally throughout these plants in the only four British species examined. Hence it appeared interesting to extend the inquiry to the exotic species, and especially to the epiphytes of the order; which I have been enabled to do through the courtesy of Dr. Hooker and Mr. De Carle Sowerby. The following are notes of parts of fresh plants received on January 26 and February 6:—*Isochilus linearis*: raphides very scanty in leaves and stem, but very plentiful in bundles in the fleshy root, without starch; dotted chains of cells in stem. *Sobralia macrantha*: raphides rather numerous in the stem, leaves, and the parts of fructification. *Calanthe vestita*: raphides abundant in scape, bracts, petals, and

other parts of fructification (no leaf examined); hairs of scape jointless, and not glandular. *Dendrobium nobile*: raphides abundant in very young leaves, less so in old leaves and stem, and very rare in the root. *D. pulchellum*: bundles of raphides in the stem and fleshy leaves, and very rare in the root. Leaf of another *Dendrobium*: raphides rather scanty, but large. Leaf of *Aërides odorata*: several bundles of raphides, but not abounding. Bit of leaf of *Trichotosia* (a section of *Eria*): bundles of large raphides abundant in cells, and numberless smaller raphides in the field of vision; hairs of leaf red, smooth, jointless, swollen at base, and not glandular. *Schomburgkia crispa*: bundles of raphides abundant in swollen part of stem, scarcer in its thin part and leaf; woody part of stem made up of dotted vessels. *Cattleya Mossiae* (leaf and swollen part of stem): raphides abundant. *Phaius grandifolius*: bundles of raphides swarming in the leaves, bulb, and root-fibres; in the bulb, raphis-cells very large and hyaline, also a profusion of beautiful, conical, large starch-granules, average length $\frac{1}{16}$ th, and breadth $\frac{1}{16}$ th of an inch. *Brassia* (a bit of the leaf, as also in all the following): raphides, but not very plentiful. *Oncidium*: very few bundles of raphides. *Megaclinium*: raphides abundant, and a beautiful subcuticular sphæraphid tissue (Annals, Sept. 1868, Pl. IV. fig. 18); the diameter of each of the sphæraphides regularly about $\frac{1}{16}$ th of an inch. *Ansellia*: raphides rather numerous. *Bolbophyllum*: raphides pretty numerous.

Aracea.—Among some fragments of plants to aid this inquiry, which were obligingly supplied by Mr. Cox, the excellent superintendent of the Redleaf Gardens, is part of the leaf of *Richardia æthiopica*, which I find abounding in biforines, the raphides escaping, under gentle pressure, regularly from both ends of the oval cells.

Edenbridge, Feb. 12, 1864.

ERRATUM.—In the February Number, page 121, line 34, for “classification” read “discrimination.”

[To be continued.]

XXVI.—On the Extent, and some of the Principal Causes, of Structural Variation among the Diffugian Rhizopods. By G. C. WALLICH, M.D., F.L.S., &c.

[Plates XV. & XVI.]

THE wide range of variation manifest in the external characters of the non-testaceous Amœban and Actinophryan Rhizopods has been already discussed by me in several papers which have

appeared in the 'Annals' during the course of the bygone year. On the present occasion I propose to show that amongst the testaceous genera of the same order (namely, the Proteina*) this tendency to variation is no less marked, and that it is attributable (as was stated to be the case in the non-testaceous genera) rather to the ever-fluctuating conditions of the medium by which the organisms are surrounded than to any special hereditary idiosyncrasies by which certain characters become impressed upon certain races of individuals.

The primary points to be considered are, whether the degree of variation observable in the soft parts—or actual bodies of these creatures—is at all commensurate with that which is traceable in their tests; and whether there exists such an intimate relation between the changes in figure, composition, size, and colour of the tests, and of the sarcode-bodies over which they are formed, as to indicate varying degrees of physiological advance or degradation. For it cannot be too strongly urged that, on the proper apprehension of these two questions must mainly depend our ability to discriminate between characters that are, and those that are not, of true specific value; and that every incautious addition to our lists of species, whilst inevitably operating as an obstacle in the path of those persons who are desirous of studying the biological relations of the lower forms of organic being, must also tend materially to augment the difficulties which stand in the way of a natural and easily available systematic arrangement.

As stated by me in the 'Annals' for June last (p. 452), it seems almost impossible to examine the sarcode-body of *Diffugia* and *Arcella*, on the one hand, and of *Euglypha* and some allied forms, on the other, without perceiving that in each case these organisms ought to be comprehended under a single genus. Between the degree of differentiation attained by the sarcode of *Diffugia* and *Arcella* there is nothing suggestive of more than specific distinctness. Both these forms are *Amæbe* in the strictest sense; that is to say, their bodies consist of sarcode in which the degree of consolidation of the external layer for the time being is so complete that the outline of the surface,

* Under this designation are united by me those Rhizopods which differ from the preceding orders (namely, the Herpneumata and Protodermata) in the possession both of a definite nucleus and contractile vesicle. They are divisible into two primary families, the "Amœbina" and "Actinophryna," based principally on peculiarities presented by the sarcode-body.

The *Diffugidae* constitute a subfamily of the *Amœbina* standing naturally apart from the remaining testaceous forms which present the Actinophryan type of ectosarc and pseudopodia, and hence constitute a subfamily of the Actinophryna under the name of the *Euglyphidæ*. (See classification of these subfamilies, at page 240).

with the exception of a small area posteriorly, is devoid of granularity, and possesses no adhesive power. Hence the pseudopodia do not coalesce unless during the inception of food. Again, the bodies of *Diffugia* and *Arcella*, as is the case in *Amœba*, exhibit a determinate anterior and posterior portion, the projection of the lobate or finger-like pseudopodia taking place only over the former region, whilst the latter serves, through an increase of the adhesive power over a small area, to furnish attachment to the fundus of the test interiorly. In both, the nucleus and contractile vesicle or vesicles, after disengagement from the test, are found to be identical in character, and to exhibit the same tendency to subdivision, at certain periods of the creature's history, that is witnessed on a larger scale in the *Amœba* proper. And, lastly, the reproductive process is the same as regards every known essential particular*.

In the case of the freshwater *Euglyphida*, although the difficulties of observation are somewhat increased in one direction, owing to their more minute size, these are more than counterbalanced in another by their freedom from mineral particles, which usually interfere with vision; and, with a little care, we are enabled to perceive that an absolute identity in the character of the soft parts pervades this group also. Indeed this identity would seem to have been recognized, inasmuch as the *genera* into which the species and their varieties have been constituted by different observers are distinguished from each other altogether by the shape, size, colour, and markings of the tests. Under a cautious examination of the sarcodemass, we are enabled to perceive that the *Euglyphida* differ from the *Amœba* proper and *Diffugida*, inasmuch as their ectosarc is minutely granular, and possesses a decided degree of adhesive viscosity throughout the entire body, whilst their pseudopodia also exhibit a finely granular outline, are filiform,

* Even when the Diffugian tests are constructed of the most hyaline materials, and specimens are obtained with the slightest intermixture of extraneous matter, it is extremely difficult to trace out the appearances presented by the organs they enclose, with any approach to certainty. Indeed the attempt to do so is vain, unless we happen to meet with individuals the tests of which are constructed of mineral fragments flat enough and thin enough not to interfere materially with the passage of the rays of light. Under proper management, however, it is quite possible so to regulate the action of the compressor as to keep the soft parts more or less *in situ* after extrusion from the test; whilst we may often assure ourselves that objects within the test, supposed to be the nucleus, contractile vesicles, or food-particles, are in reality so, by carefully watching their transit as they escape under pressure,—bodies like the sarcoblasts and crystalloids, the positions of which within the endosarc are indeterminate, of course admitting of an equally satisfactory scrutiny, whether seen without or within the test.

tapering to some extent, radiate, and freely coalescent; while, coupled with and perhaps dependent on these characters, the pseudopodia of this subfamily, as if to compensate for the restricted power of locomotion possessed by them in comparison with the *Amœbe* proper, are much more active—the rapidity with which they admit of being projected outwards or withdrawn into the test being unequalled in any other form, and presenting the most wonderful example of inherent contractility in an amorphous animal substance that is to be met with in either of the great organic kingdoms. It is hardly necessary to point out, however, that, in the absence of other characters, this peculiarity can no more be regarded as indicative of generic, or even specific, distinctness than the difference in the speed of the racer and cart-horse can be regarded as indicating their specific separation.

But it is in the features presented by the tests of the Diffusian group of freshwater Rhizopods that the tendency takes place to the inordinate modification to which allusion has been made, and enables us to perceive that it is dependent on the fluctuating condition of the water in which they live and of the mineral ingredients peculiar to the soil of each locality. For, as might naturally be expected from the protection afforded by the tests, the soft parts are uninfluenced by many of those agencies which produce changes in the external characters of the naked genera; and hence we are enabled the more readily to assure ourselves of the unity, in each case, of the generic type which pervades the two groups into which these organisms appear to me naturally to resolve themselves.

I propose, in the first place, to adduce the grounds on which I base the opinion that, with the exception of a few *permanent varieties* which exhibit a type capable of being hereditarily transmitted, the whole of the varieties may be regarded as the result, 1st, of modifications in figure, dependent in some instances on the inability of the test to sustain its own weight, and in others on its tendency to assume curvature or obliquity from the action of running water; 2ndly, of modifications in the materials of which the tests are constructed, depending sometimes on the kind of mineral substances procurable in particular localities, sometimes on a hitherto unrecognized and very remarkable union between the chitinous basal substance (which is an exudation from the animal) and the mineral particles which that substance serves in the first instance merely to cement together; 3rdly, of modifications in size, depending probably on the age, the perfect or imperfect nutrition of the individual, and also on the capability of the test to alter its form after having become consolidated to a certain extent by the addition of mineral particles; 4thly and lastly, of

modifications in colour, arising partly from the nature of the food that has been incepted by the animal, partly from the external incrustation of organic or inorganic debris, and occasionally from the depth of tint of the chitinoid basal substance.

Before proceeding, however, I may be permitted to state that the whole of the forms about to be described in these pages have not only been met with by me abroad, in the plains of Lower Bengal, in the Himalayan Mountains, on the confines of the Arctic Circle, in Labrador, and in Nova Scotia, but, excepting the two or three extreme *varietal* forms encountered only in the most remote of these localities, the whole are to be found abundantly in nearly every pool and streamlet throughout England. It may also be mentioned that my conclusions have in no case been arrived at from the examination of solitary specimens, but only after a laborious comparison of those which have occurred in sufficient numbers and in sufficiently varying stages of growth to guarantee the avoidance of exceptional examples*.

Taking the several kinds of varietal modification referred to in the order of their importance, I have, in the first place, to notice the one involving the *shape* of the test, or, as Dr. Carpenter appropriately designates it, in speaking of the Foraminifera, "their plan of growth." For if, as he has urged, this furnishes no natural basis for generic distinction in the family to which he more especially refers, in which the structure of the shell is at times highly complex, it is obvious that the plan of growth cannot afford a trustworthy distinctive character in a group of organisms the tests of which are of the simplest kind, and hence more liable to come under the operation of varying physical influences.

After having most carefully studied the several varieties of Diffugian test, and compared the characters of the whole series with due regard to the local conditions under which they were found, I have been irresistibly led to the conclusion that they have sprung from *one* primary or larval form; in other words, I conceive that the whole are referable to a single specific type, and that, whatever varietal figure the mature test assumes, such figure may be the result of peculiarities in the external conditions by which it is surrounded, and not the result of hereditary transmission in each case. So that, supposing A to represent the prevailing form of the Diffugian test in its earliest stage, under the varying conditions of the medium by which it

* The foreign materials to which I have just alluded still remain in my possession, in a mounted as well as an unmounted state; whilst all the specimens from which I have made my drawings are preserved for verification by those naturalists who are engaged in the study of the Rhizopoda.

is surrounded it may ultimately assume the shape of either of the varieties W, X, Y, or Z.

Of course, it is not only possible, but highly probable, that the type of the mature variety may, in the greater number of forms, be reproduced in the progeny; but, be this as it may, there can be no doubt of the fact that, with a solitary exception, specimens are to be found in every habitat, the characters of which overlap, so to speak, those of the most closely allied varieties to such a degree as to prove that there exist no true specific limits between them; whilst it is interesting to observe that the exceptional form referred to, namely, *Diffugia spiralis* (Pl. XV. figs. 3, 3 v & Pl. XVI. fig. 24)*, instead of disproving the fact advanced, confirms it, as shall hereafter be shown, inasmuch as the recurved shape assumed by the test would seem to be produced by a purely mechanical agency which is only able to exert influence upon it when it approaches maturity.

It is also deserving of notice, as bearing upon the probable existence of only a single distinct specific type in *Diffugia*, that the number of mature tests in which the globular form prevails falls immeasurably short of the number of young tests exhibiting that shape†. This may, no doubt, be accounted for on the supposition that the greater proportion of this the prevailing form of young test may perish before they advance further in growth. But there are no grounds for such an assumption, since the minute tests occur wherever *Diffugiæ* are most abundant and the conditions for existence may therefore be assumed to be the most favourable; and, as already stated, every gradational variety is traceable even from this early stage. It seems much more likely, therefore, that the globular figure, as shown in Plate XV. fig. 1‡, is made to assume either of those represented in the surrounding figures 2, 3, 4, & 5, according as the earliest

* When noticing this variety of *Diffugia* (Annals, June 1863, p. 451) as having been observed by me in England for the first time, I was not aware that it had been detected so long ago as the year 1815 by M. Leclerc, and accordingly gave it the provisional name of *D. proteiformis*, var. *septifera*, in allusion to the dithalamous tendency evinced by its test. I am glad to find that I am supported by Perty in the view that it is a "monstrosity" of the form named, and not a distinct specific type.

† It may be mentioned that the most minute recognizable tests of *Diffugia* measure about $\frac{1}{100}$ th of an inch in diameter, whilst the sarcoblasts of this genus, when extruded under pressure from the test so as to be examined separately, average about $\frac{1}{100}$ th of an inch.

‡ In order to make the characters referred to in the text more readily intelligible to my readers, all references connected with the subject of varietal modification in *shape* are made to the outline-figures in Plate XV.; whilst those bearing on the composition and general outward features of the tests are made to the detailed figures of the same forms given in Plate XVI. Exceptional references will be expressly indicated.

addition of mineral matter, if cemented to a point opposite the aperture, may tend by its weight to depress the test in the direction of its axis*, and thus give rise to the flattened series of forms of which *Diffugia aculeata* is an example (fig. 4 k), and *Arcella vulgaris* (Ehr.) = *Diffugia vulgaris* (Wall.) is the extreme limit; or cause it to assume the elongated cylindrical outline of the mitriform series, of which such varieties as *D. acuminata* and *D. mitriformis* are mature examples, should the particles of mineral matter first employed be attached at points intermediate between the aperture and the apex of the test (figs. 2, 2 p, q, 3, 3 a, b, c, &c.).

It is true that in *Diffugia vulgaris* (fig. 1 y) the test is normally depressed even in the entire absence of all foreign matter. But it is also deserving of note that the most delicate and hyaline tests of this species are those which present the greatest degree of depression; whereas the stouter and more deeply coloured mature tests are those in which the hemispherical shape is most perfectly maintained. Here then it is quite evident that strength of the basal chitinous material, as compared with the weight it has to support, constitutes a *mechanical* condition upon which the modifications of figure are dependent, and hence lends confirmation to the view advanced with reference to *Diffugia*, even admitting, for the sake of argument, that *Arcella* and *Diffugia* are generically distinct.

Again, where the mineral matter is so uniformly distributed over the young spherical test as to cause no deviation from its normal outline, the globular or subglobular figure is maintained, and attains its maximum development in such forms as are represented by figs. 4 & 4 a-g.

In another set of cases, in which the axis of the test may be rendered oblique by a preponderance of mineral particles taking place on one side, or through the pressure of a stream flowing in one direction and thus acting upon the young test whilst yet unconsolidated, the oblique or pouch-shaped series of forms is produced, of which the simplest example is devoid of horn-like appendages (figs. 5 a, 5 d); and a new variety, common in many places, but most fully developed in Greenland, namely *D. cassis* (figs. 5 b & 5 c), may be taken as the extreme example.

I have already given what I regard as the only probable ex-

* By the axis of the test is meant the imaginary line which would pass through the centre of the plane of the aperture and the apex. As the pseudopodia are invariably projected through the aperture, the extremity at which it occurs is called the anterior, the opposite being the posterior, aspect. The apex of the test is the point furthest removed from the axis of the aperture, whether reference be made to the symmetrically or asymmetrically formed series.

planation of the entire absence of young tests presenting the well-marked peculiarity of *Diffugia spiralis*, namely, that it is a modification of form produced by mechanical causes which only come into operation when the mitriform or acuminate test (figs. 2 p, 3 c, 3 b) approaches maturity. This may, however, be regarded as an exceptional case. But in *D. corona*, a variety found in tolerable abundance on the borders of the Gangetic Sunderbunds, and which is represented in figs. 4 b, 4 c, I have, in like manner, failed to discover young tests in which the crenulated aperture is associated with the horn-like processes seen when it is mature. Medium-sized globular tests occur, however, in which the crenulate aperture is fully developed (fig. 4 a); and, on the other hand, mitriform specimens, such as those shown in fig. 3, in which a varying number of crenulations around the aperture is observable. Now there is nothing to distinguish the globular form *with* the crenulate aperture (fig. 4 a) from the simple globular form *without* it (fig. 4 h), which constitutes one phase of *D. proteiformis* as given by Ehrenberg (*Infusionsthierchen*, taf. 9. fig. 1 b), but the feature referred to; whilst the crenulate aperture occasionally reappears in the tuberculate variety of the latter form (fig. 4 g). Lastly, individuals are frequently met with of the mature *D. corona*—that is, in which the horns are fully developed,—but exhibiting a perfectly plain aperture.

Three conclusions are deducible from these facts,—the first being that neither the crenulation nor the cornua are constant in the variety named *D. corona*, singularly distinct though it appears if considered without reference to the osculant forms by which it is surrounded; the second, that there is nothing except the crenulation to distinguish the entire globular form with the crenulation (fig. 4 a) from the universally distributed globular variety (fig. 4 h); and the third, that the crenulate margin of the aperture is not even confined to the globular series of tests, but is to be seen occasionally in the mitriform varieties; whilst neither in one set of forms nor in the other is there anything like constancy in the number of the crenulations themselves.

If we turn to the series of mitriform tests, of which the beautifully proportioned variety *D. lageniformis* (fig. 2 c) would seem to be the culminating point, we find that the characters combining to make up this figure are gradually developed through the whole of the mitriform series, which has heretofore been subdivided, on the most trivial grounds, into four so-called species, namely, *D. proteiformis*, *D. oblonga*, *D. acuminata* (Ehr.), and *D. pyriformis* (Perty). Thus, commencing from the earlier mitriform test, as shown in fig. 2, there is an unbroken transition, both as regards extension in the longitudinal and trans-

verse axis of the test, to the broadly ovate shape shown in fig. 2*g*, and the almost cylindrical varieties which have been termed *D. oblonga* or *D. acuminata*, as they happen to present the acuminate or simply convex outline posteriorly (figs. 3*t* & 3*b*) ; whilst, by a compromise, as it were, between such shapes as are depicted in figs. 3*t* & 2*g*, we have the balloon-like or pear-shaped varieties (figs. 2*b* & 3*s*).

Again, taking the young test (fig. 2) as a starting-point, we occasionally meet with what, at first sight, appears to be a well-defined narrow but plain band surrounding the aperture, as shown in fig. 2*a*. But this is by no means confined to one form of test ; it is to be seen now and then in the aperture of such forms as figs. 2*g*, 4*h*, 4*g*, and indeed in all the varieties of the forms represented in figs. 2*i*, 4, & 4*g*, and depends on the eversion of the marginal border of the basal chitinous layer so that it overlaps the margin of the foreign particles impacted on the outer surface of the test. In short, this is the rudiment of the lip which becomes so largely developed in the extreme variety of the series, namely, *D. lageniformis* (fig. 2*c*).

Now the crenulate margin of *D. corona* and the other varieties that present this character is merely a modification of the apertural band just referred to, in which the margin of the basal chitinous layer, instead of being unbroken, is formed into a series of minute crenulations, the points of which alone reach the extreme edge of the aperture, without apparent eversion, however.

We can hardly fail to perceive that this arrangement of the apertural margin of the Diffugian test is evidently the best fitted to admit of the easy projection and retraction of the glairy pseudopodia. I believe it pervades the entire series of varieties, although more readily, or at all events more generally, recognisable in certain forms. In all we can perceive that the greatest care seems to be lavished on the selection of minute mineral particles for deposition immediately around the aperture ; and, as I shall presently show, that in those examples in which there is no admixture of extraneous mineral matter, but the entire test is made up of chitinous substance, there is evidence of a like degree of adaptative power. Were the evidence otherwise incomplete, I conceive, however, that the structure of the beautifully moulded lip of *D. lageniformis* would prove conclusive ; for in it we find that whilst the mineral particles with which the rest of the test is as it were tessellated extend to the commencement of the everted portion, from that point they gradually dwindle away, until at last it is only with considerable care in the adjustment of the light and focus that we are enabled to perceive the almost hyaline margin of the overhanging lip.

Lastly, we arrive at the singular group of forms in which the

test is so far asymmetrical (and in this respect differs in character from all those previously described, with the exception of *D. spiralis*), that a section passing transversely through the apertural plane would form two very unequal portions. Nevertheless it can be shown that even here there is no valid ground for assuming specific distinctness, or that the figure of the test is not determined by *extrinsic* conditions.

I have already explained how readily the slightest inequality in the distribution of the mineral particles in the earliest state of the test may cause it to assume an oblique figure, and that such figure may, without any improbability, be also imparted to it, in the young state and (as will hereafter be seen) at subsequent periods of its history, by the action of running water,—*D. spiralis* affording a marked example, in which the latter agency would seem to produce the effect in the most signal degree*. Now, although I have heretofore been unable to satisfy myself that in habitats in which there is a current, and in those in which there is none, the asymmetrically and symmetrically shaped tests respectively predominate to such an extent as to leave *no* room for doubt as to the efficacy of the second cause I have suggested, from such observations as I have made on the character of the spots from which I have obtained *Diffugiæ*, I cannot help believing that this is the case. And whilst I confine myself, at present, to stating the matter suggestively, I may mention that in three localities very widely removed from each other, and in which the nature of the land is itself evidence of the liability or otherwise to a constantly running state of the water, this preponderance seems at all events undeniable. Thus on the borders of the Sunderbunds, where the whole country is a vast swamp, there are pools perpetually fed with fresh supplies of water, but only subject to currents during the inundations occurring during the rainy season. From such pools I obtained the most highly developed varieties of the symmetrical Diffugian tests I have ever seen, namely, *D. corona* and *D. lageniformis* (figs. 2 c and 4 c),—the oblique series and even *D. spiralis* being, however, moderately represented. At Goodhaab again, in West Greenland, I obtained material from pools occurring along the course of somewhat precipitous valleys, and accordingly under the constant action of the mountain streams by which these waters were supplied.

* Fig. 3 v gives the outline of a normal test of the pyriform variety of *Diffugia proteiformis*, whilst the dotted outline represents an ideal view of the same test made to assume a *retort*-shape by a force acting upon it laterally and in one direction. It is an instructive fact that the semicircular fold observable in the neck of this test and the neck of an ordinary retort are precisely similar; indeed the derivation of the word “retort” explains the manner by which the curvature is effected in both cases.

In these the most highly developed forms were the oblique ones, —*D. cassis* (which may be regarded as the limit of this series, as I have already shown) attaining its extreme characters (figs. 5 b, 5 c), and, what must be considered as equally significant, the tests of the larger oblique varieties, and also of the common mitriform series, being loaded to an extraordinary degree with mineral matter, chiefly in the shape of diatoms, doubtless to render their weight greater (Plate XVI. fig. 9).

Lastly, in a locality close at hand, namely Hampstead, in little pools extending down the slopes and perpetually subject to a dribbling stream, the oblique varieties are abundant, though not attaining the extreme characters of *D. cassis*—such varieties as *D. aculeata* and *D. spiralis* being common; whilst the tests of the mitriform series are frequently covered with masses of mineral matter so large in proportion to the entire size of the tests, and so irregular, as to render it far from improbable that their weight and outline must exercise some power in enabling them to hold their ground.

But, to revert to the varietal development of the series now under notice, taking the globular young test once more as a starting-point, we find an extremely gradual transition taking place, first till we arrive at full-sized mature tests the spherical outline of which is only disturbed to the extent of making the aperture appear slightly excentric. This variety is represented in fig. 4 k. In the latter example, however, we perceive the hollow horn-like processes which have been regarded as indicating the species to which the name of *D. aculeata* (*Arcella aculeata*, Ehr.), has been given. Now there is not a single character to distinguish a variety of this form without horns from the common globular variety (fig. 4 h), save this trifling obliquity or compression. On the other hand, there is nothing to separate the horned variety (fig. 4 k) from *D. corona* when devoid of the crenulated aperture, but this same obliquity; for although the cornua are generally distributed only over that half of the test furthest removed from the aperture, this peculiarity is occasionally met on the side of *D. corona* by a similar asymmetrical disposition of its cornua; whilst specimens are now and then to be found of *D. aculeata* in which the cornua really form a complete circlet, but, owing to the tendency of the test to rest in a position perpendicular to the plane of the aperture, the part anterior to the aperture prevents a certain portion from being easily seen.

In the variety shown in figs. 5 a, d, & e, we have the transition from the plain, small, oblique test (fig. 5) to the form of *D. aculeata* shown in fig. 5 m. But two slight peculiarities now make their appearance,—the first being that the horns become longer and identical with the broad-based apical horn sometimes seen in the

acuminate variety of *D. mitriformis* (fig. 3 c); whilst the second consists in a partial *inversion* of the apertural lip, instead of an *eversion*, as occurs in *D. lageniformis* (fig. 2 c). But the chain of forms is rendered still more complete; for individuals are now and then met with, of the mitriform series (*D. acuminata*), with a couple of cornua placed on each side on the actual apex of the test (Plate XVI. fig. 8); so that between the mitriform and the oblique varieties under notice the compressed and oblique figure and commencing inversion of the lip constitute the sole difference.

Lastly, we arrive at the extreme limit of the oblique series, in which, however, there are no cornua; but excentricity of the aperture becomes greatest, and its entire margin is inverted so as to constitute a short tube extending upwards into the cavity of the test. This last character, singular as it appears, has its counterpart in the Entosolenian group of the Lageniform Foraminifera; and I am glad of the opportunity of stating that the generic separation of *Entosolenia* from *Lagena* is insisted on by Professor T. R. Jones and Mr. Parker for the same reasons that are here advanced, namely, that the character indicates only *varietal* distinction ('Introduction to the Study of the Foraminifera,' by Dr. Carpenter, pp. 157, 158).

The very singular helmet-shaped variety (figs. 5 b, 5 c), which may be regarded as the antithesis to *D. lageniformis*, is represented as it occurs in the Greenland material. In it we merely perceive, in its most exaggerated degree, the obliquity already so marked in the variety shown in fig. 5 m, the depression of the test, together with the inversion of the margin of the aperture, occurring in the early form shown in figs. 5 & 5 m, clearly proving how the latter connects *D. cassis* with the globular varieties.

One more transition in the Diffflugian series remains to be noticed before I conclude this section of my subject. It is an important one, however, since it seems clearly to indicate that, whilst the animals of *Diffugia* and *Arcella* are generically identical, there is no such difference between their respective tests as can constitute more than a *subspecific* separation.

In the Diffflugian test we constantly witness a structure similar to that first pointed out by Messrs. Jones and Parker as pervading the group of Foraminifera to which they have assigned the name of Lituolidæ. But we must bear in mind one point of difference—namely, that whereas in the Lituoline group the modification of material employed in the construction of the shell entirely supplants the normal calcareous material which is secreted by the animal, amongst the *Diffugia* there is no normal *mineral* secretion to supplant*. I allude to the composition of

* I am aware that the word "secrete" expresses more than we have

the test in *Diffugia* of arenaceous particles cemented together by a chitinous exudation from the animal, precisely after the same fashion as the chitinous and arenaceous elements of the shell are cemented together in *Lituola*. Indeed in some specimens of the more common varieties of *Diffugia*, in which the chitinous matter assumes a sienna-tint, it is extremely difficult, if not impossible, to say, on mere inspection of the broken-up wall of the test, whether we have under our eyes a portion of a Diffugian test or a Lituoline shell*.

In *Arcella*, on the other hand, the test is almost invariably only chitinous in its composition; and although we frequently meet with tests nearly devoid of mineral particles, and closely resembling that of *Arcella* in its hemispherical or depressed outline, central aperture, and inversion of the lip, a very small degree of skill enables us to perceive that the object before our eyes does not present the characteristic symmetrical reticulation of that form, but is in reality an osculant variety from the side of *Diffugia*†.

If we now turn to the *figure and plan of growth* of the tests, we shall, I think, perceive that these are analogous in the two forms.

Commencing with the earliest state of the Arcelline test, (unless I am much mistaken) *Arcella hyalina* (Ehr.), *Arcella patens* (Clapar. and Lach.), and several varieties of *Orthosira* or *Melosira* discs have all been confounded more or less with it. That this should have been the case is in nowise surprising when we consider the minute and almost invisibly hyaline character of the test of *Arcella* at this period. Without, however, asserting positively that this has been the case, I may state that minute forms answering precisely to the published characters of the Rhizopods (not the Diatoms) mentioned above have been

here a warrant for assuming; but, keeping in view the fact that the calcareous or siliceous matters of which such structures as the shells of the Foraminifera and internal skeletons of the Polycystina are respectively formed are eliminated from the water in one condition, and somehow or other reproduced as an exudation from the animal in another, we certainly express the result by adopting the word, although the process by which it is brought about may be regarded as exceptional.

* The appearances presented under the microscope by the broken-up test of one of these *Diffugia*, or a shell of *Lituola*, are very similar to those visible, by the unaided eye, in the beautifully constructed cylindrical tubes of *Pectinaria*; and they indicate a degree of adaptative skill which, however wonderful it may be thought in the articulate animal, is doubly wonderful in the Protozoan.

† Such a variety is referred to by Ehrenberg (*Infusionsth. Taf. ix. figs. a, c*) as *Arcella aculeata*, showing how very closely *Diffugia Arcella* (Pl. XV. fig. 1 y) and the plain form of *D. globularis* resemble each other in character.

repeatedly observed by me, in which it was only by dint of extreme care in manipulation of the light, the focus, and the specimens themselves, aided by the employment of high magnifying power, that it became possible to perceive that, instead of the test being a simple cup-shaped disc, it was shaped like the mature *Arcella*—the plane surface being present, and at its centre the minute aperture through which the pseudopodial sarcode was protruded.

In somewhat older specimens, the figure of the Arcelline test admits of no doubt; but in these the convexity is generally very trifling (probably, as before stated, in consequence of the still extremely delicate texture), and the inversion of the margin of the aperture is but slight. At this stage, barring the presence of mineral particles in the test of the ordinary *Diffugia*, and the absence of obliquity in that of *Arcella*, there is nothing to distinguish one test from the other. The inversion of the lip is but a repetition of what has already been shown to take place in *Diffugiæ*; so is the depression of the test; whilst, lastly, the variety of *Arcella* to which the name of *A. angulata* has been given is nothing more than the common form of the mature Arcelline test pulled inwards at various points of its convex aspect by the action of the stolons, which are constantly seen extending from the posterior portion of the sarcode-body, and enable the creature to carry its test on its back, just as a snail carries its shell (Pl. XVI. fig. 36).

Under these circumstances, however convenient it might be to retain the two generic appellations, simply because we have become familiar with them, if we regard classification in its only legitimate light, namely, as a guide in the interpretation of the physiological differences prevailing through the organic world, we must either consent to forego convenience by breaking down the fictitious generic boundary-line which has hitherto been assumed to exist between *Arcella* and *Diffugia* or perpetuate a very serious error.

With regard to the means whereby the composite tests are built up, it may be recollected that, in the 'Annals' for last January (p. 78), I suggested the probability that in *Diffugia* the external portion of the test receives fresh additions either of chitinous or mineral matter through an expansion of the sarcode-substance reflected back from the main aperture, or formed by the coalescence of sarcode-stolons which escape through one or more pores distributed here and there over its surface. This view appears to be substantiated in a great measure by the fact that in the ordinary forms, whatever may be the mineral composition of the superficial layer of the test, there is generally to be seen below this, and resting immediately upon the

primary chitinous wall of the chamber, a series of irregular micaceous-looking plates. Indeed it is difficult to conceive how additions could be made externally to the thickness of the test by any other method than the one indicated,—the accumulation of layer upon layer of mineral particles being, in some cases, carried to such an extent that the wall of the test attains considerable thickness and an outline so bold and rugged as to present the appearance, under the microscope, of a mass of coarse sandstone rather than a built-up chamber tenanted by a living organism.

I have never succeeded in actually witnessing the process of test-construction going on in *Diffugia*. But were the particles of mineral matter conveyed to their resting-places by the pseudopodia, it seems hardly possible that it should have escaped notice altogether; and, on this account, I am rather inclined to think that, whilst the creature is enabled by means of these organs to select such particles as are best fitted for its purpose, they serve merely to drag the body towards the particles, and eventually to bring that portion of the test upon which they are destined to be lodged in contact with them.

No doubt this presupposes a selective power far in advance of any faculty we should *à priori* be inclined to attribute to organisms of so rudimentary a type. But to deny this power is simply to deny an established fact which can be accounted for in no other way. We have only to examine such tests as are represented in Plate XVI. figs. 9, 10, 16, 20, 22, &c., to satisfy ourselves that the collection of mineral particles of certain dimensions, and of certain kinds, must necessarily have been effected with a view to serve some particular purpose. But, wonderful in itself as this faculty must appear, I beg to draw special attention to it, inasmuch as it tends, in conjunction with other distinctions to which it is unnecessary for me at present to refer, to establish the impassable boundary-line betwixt the animal and the plant—between the manifestation of vital, chemical, and physical agencies on the one hand, and these combined with psychical agencies on the other. And I venture to say that, however stubbornly we may ignore this doctrine, simply on the score that it has heretofore defied our comprehension, the day will assuredly come when, with the assistance of a more perfect knowledge of organic life than we as yet possess, its accuracy shall cease to be impugned.

The next series of varietal modifications, in the order of their importance, is that involving the *materials* of which the Diffflugian test is constructed.

I have, throughout these observations, spoken of the exudation from the animal which constitutes the basis of every Rhizopodal test (and of which the test is exclusively made up in certain

genera) as a *chitinoid* material. By this expression it is simply intended to convey that the material referred to presents as close an approach to the substance known as chitine as is determinable from the optical characters of portions far too minute to admit of chemical analysis; and I believe I merely adopt a view very generally entertained by competent observers, when I give it this designation. But whatever may be the precise chemical composition of the substance, the name serves to indicate a well-known part of the structures; and, to say the least of it, this is a higher quality than can be assigned to many of the scientific terms which are now and then submitted to the public.

In the majority of the *Diffugian* tests, this chitinoid material forms a continuous and smooth layer internally, it being on the external surface alone that mineral particles are impacted. It is also a most interesting fact, that no vegetable or extrinsically derived animal substances are employed for the consolidation of the test, and that the particles selected are, I believe invariably, of mineral nature. On the other hand, it is manifest that the selective power is carried to such an extent that colourless particles, sometimes quartzose, sometimes felspathic, sometimes micaceous, are always chosen* — the absence or presence of angularity in these particles being of course dependent on the condition of the sandy matter in each locality.

The particles would seem to be impacted into the chitinoid matrix just in the same way that a brick is pressed into the yielding mortar; and this too in so skilful a manner as to leave the smallest possible amount of vacant area; whilst in the specimens in which tabular or micaceous particles are used, these are sometimes disposed with such nicety that there is no overlapping, but the small fragments are placed so as to occupy the spaces left between the larger ones. Figs. 11, 15, 20, in Plate XVI., are examples of this kind †.

It is curious that even in pools or streamlets in which the deposits seem to consist almost exclusively of vegetable débris, the *Diffugia* still manage to find mineral matter sufficient for their purposes; whilst, as already stated, in those places where they run a risk of being washed away by running water, they reduce the chances of the catastrophe as far as possible by loading their tests with the largest particles and the greatest quantity of mineral matter. Figs. 9 & 10, the one from Greenland, the other from a little streamlet at Hampstead, are moderate examples of this loading, which, it may be remarked, is

* In Indian specimens I have occasionally detected the siliceous spicules of *Spongilla*.

† Plate XVI. will now alone be referred to, unless the contrary be expressly stated.

more frequent in the mitriform than in the globular series. It also takes place more frequently in certain varieties than in others of the globular series, as will be seen on reference to figs. 17, 18, & 27 on the one hand, and figs. 19, 20, 22, & 23 on the other.

But the selection of mineral particles is not confined to strictly inorganic substances. The *Diffugia* seem to know that in the valves of the Diatomaceæ are combined the properties best suited to their wants—that is to say, transparency and forms capable of being easily arranged,—at the same time that the diatoms occur as epiphytes on the aquatic plants upon which they themselves frequently find feeding-ground. And it is a remarkable circumstance that we can generally tell whether diatoms are or are not plentiful in a given locality by observing the share taken by them in the composition of the Diffugian tests. Thus, to cite an example close at hand, in the Hampstead pools the predominant diatoms are *Pinnularia* and *Eunotia*—the former of very large size, the latter extremely minute*. Hence the first is but rarely seen impacted into the tests, and when present it is of medium size. The second, however, constantly occurs, and, in the curious variety of test referred to as *D. spiralis*, and likewise in the globular and lageniform series, they often constitute a very large percentage of the mineral matter (figs. 18, 18a, 24b, & 32†).

In the Greenland mountain streamlets from which I obtained some of my specimens, *Eunotias* occur very abundantly, and under a remarkable variety of forms. In some tests they constitute the entire mass of mineral matter, and, as in the Hampstead material, pervade nearly every shape of test, though much less predominant in the depressed series (figs. 9 & 27).

I have now to speak of several novel modifications in the outward characters of the Diffugian tests which have heretofore been observed by me, for the most part amongst the varieties of the mitriform and lageniform series, and which I have been able, only within the past few months, to trace as an unbroken chain from the forms already described to those in which the chitinoid matrix presents no appreciable admixture with mineral matter.

The first indication of this very remarkable and instructive

* This diatom would seem to have been hitherto undescribed. It is stipitate, the valves being generally from $\frac{1}{32}$ to $\frac{1}{16}$ of an inch in length, and occurs in crowds around a filamentous "frond," appearing to be very generally distributed. An extremely minute *Naviola* also occurs, but is rarely employed in the construction of the test—thus affording another example of selective power.

† The two figures 24 & 24a are not intended to show these diatom-valves; but certain cylindrical or, as I formerly called them ('Annals,' June, p. 451), pellet-shaped cylinders, which will be more particularly referred to presently.

series of forms was detected by me last autumn in the Hampstead material, and described and figured in 'The Annals' for December 1863, under the name of *Diffugia pyriformis*, var. *symmetrica* (*loc. cit.* p. 458, plate 8. fig. 16). For facility of reference, I have again figured this form in the plate illustrative of the present section of my subject (figs. 26 *a, b, c, & d*). As previously stated, the test, instead of being built up of irregular mineral particles so as to impart a rugged outline, is entirely made up of hyaline rectangular plates, arranged with the greatest regularity in consecutive transverse and longitudinal rows—the smaller plates being thus disposed towards the extremities, whilst the larger ones occupy the central and widest portion of the structure. It was stated at the same time that the chemical composition of these plates had not been ascertained by me (the reason being that they do not occur in sufficient quantity to render experiment practicable), but that there was ground for believing their nature to be crystalline and siliceous—firstly, because the plates resisted the effect of the heat employed in mounting the specimens, and their angles were most perfect, and secondly, because they presented no coloration when seen with the aid of the polarizer.

Since the date of my first examination of this form, I have succeeded in procuring a considerable number of similar specimens from the same locality; but, beyond confirming my previous statement in every particular, I have nothing to add, save that the test is more or less compressed laterally, whereby an elliptical outline is given to the section and aperture (figs. *c, d, & e*).

The true nature of these rectangular plates will, I believe, become manifest as I proceed with the description of the transitional states which intervene between this, the most aberrant kind of composite surface-configuration to be met with amongst the tests of the *Diffugia*, and the least aberrant forms, which are represented at figs. 30 & 31.

Fig. 27 represents the first form to be noticed. In this there is an admixture of at least four *apparently* distinct sets of bodies attached to the surface of the test. These are not arranged with the symmetrical order observable in the rectangular plates; but this may be accounted for, inasmuch as the specimen (which in this instance is a solitary one) was mounted in balsam in the material in which it occurred before I had become aware of its existence; and hence, in all probability, the pressure of the glass cover of the slide caused a certain degree of displacement. Be that as it may, it is quite manifest that we find associated together in the same individual, first, rectangular plates, secondly, others in which the plates are produced in one direction at the

same time that one of the angles is truncated obliquely, thirdly, plates approaching in outline rectangular prisms; and lastly, bodies in which the tendency to crystalline outline is lost and they pass into oblong colloid discs somewhat depressed at their centre.

We now come to the forms shown at figs. 28 & 29, in which the surface of the tests is studded with the oblong bodies, some of which, however (as is more manifest in the larger specimen), exhibit a faint but nevertheless definite approach to elongated hexagonal prisms*. These measure about $\frac{1}{3300}$ th of an inch in length. They are unmixed with any other bodies, and arranged side by side with a certain degree of regularity. In these the central depression is also distinct. The larger specimens (fig. 29) are from Greenland. The smaller, in which the discs are not more than about $\frac{1}{3000}$ th of an inch in length, are from Hampstead.

In fig. 33, which also represents a tolerably frequent variety of test, the discs attain their maximum of regularity as regards shape: all are circular, or very nearly so, and exhibit the central concavity in a very marked manner; indeed they resemble blood discs in several particulars, but of course the resemblance is merely apparent. They are of varying sizes, the largest averaging about $\frac{1}{3300}$ th, whilst the smallest are not more than $\frac{1}{10000}$ th of an inch in diameter, the larger ones being generally surrounded by groups of the smaller, although, as seen in a number of specimens, there is evidently no particular order in which they are arranged, beyond that resulting from their taking up positions side by side, and all, without exception, resting on their flat surfaces.

But it is in the series of forms already referred to as built up in a great measure of minute diatoms that we find the clue to the origin of the colloid discs and rectangular plates. In figure 32 the diatoms, as will be seen, are interspersed amongst the circular discs. The very important fact reveals itself, however, that some of the diatom-valves are becoming gradually metamorphosed, that is to say, exhibiting a gradual passage from the typical outline of the little *Eunotia* to one more closely approaching an irregular cylinder, the cylinder then passing into the elongated disc, which is at times distinctly hexagonal, and finally the elongated disc passing into the circular one. The specimen figured is not so calculated to show the transitional as the unmetamorphosed state of the diatoms; but in some individuals, and more especially in crushed specimens of these tests, every stage of transition may be clearly distinguished. As

* It is not improbable that the tendency to assume this hexagonal form may result from pressure of the discs one upon the other.

already stated, the appearances just indicated are to be found not only in the lageniform and mitriform, but also in the globular series, and in the exceptional variety *Diffugia spiralis*.

Lastly, I may mention that in certain individuals (as for example in figs. 13, 23, 24, & 24 a) the whole of the test is covered with minute cylindrical rods evidently of similar origin. Sometimes these little cylinders are straight, sometimes irregularly curved; but, as in the former examples, they are arranged side by side, and without any very distinct regularity*.

It has been already stated that no effect is produced by the rectangular plates when seen by polarized light. When, however, the discs (which in common with the rectangular plates and cylindrical bodies are themselves perfectly colourless) are seen by polarized light, the alternating changes of tint are not only distinctly visible over the test generally, but to the same extent in each particular disc,—thus indicating that the effect is not due to the presence of micaceous or other mineral films such as usually underlie the external coarse layer of sandy particles—a fact which is verified when such forms as those now under notice are broken up under the microscope.

The inference which I draw from this singularly complete series of transitional forms is, that the chitinous basal substance of the test, or (as is quite possible when we take into consideration the facts I shall presently adduce with regard to the mode in which mineral particles are arranged by an external sarcodelayer such as we see in *Gromia*) a portion of the viscid sarcode mass, combines, under the law of “molecular coalescence”†, with the siliceous or other mineral elements, and thus serves to produce all the transitional colloid bodies which occur, from the first alteration in shape of the mineral particles themselves, to the development of the crystalline tablets which were first described. One thing is quite manifest, namely, that the whole series of bodies now under notice are derived in some way from the animal, and *not* directly from the medium in which it lives; for none are traceable in a free condition in the material in which the specimens occur. On the other hand, notwithstanding the selective and adaptive faculty already shown to belong to the Rhizopod, we are not warranted in assigning to it a special *formative* power. The origin of the minute crystalloids, so abundantly present in the Amœban and Diffugian forms generally, is thus also accounted for; and step by step we are arriving at a knowledge of the mode in which the vital and

* These bodies were accurately described by me in the ‘Annals’ for December 1863, p. 456.

† See Mr. Rainey’s valuable papers on “Molecular Coalescence” in vols. vi. and vii. of the Journal of Microscopical Science.

physical forces combine, probably in every structure called organic, to build up the tissues of which the animal and vegetable kingdoms are composed.

But another important fact bearing on the series of forms represented in figs. 26-33 must now be noticed. In these the tests are sometimes so compressed as to give the aperture, when the structure rests on one side, the undulating appearance exhibited more particularly in figs. 27, 29, & 30. But more frequently, the tests are not compressed, and the aperture presents the ordinary circular or nearly circular outline. Whilst endeavouring to gain a clear end-view of one of the undulating apertures, namely the one shown in fig. 30, I found it to be closed as shown in fig. 30 *b*, and, further, the sarcode-mass gathered into a spherical mass, occupying the middle half only of the test, the transparent texture of which, in the specimen referred to, enabled me to discover that this mass was prevented from escaping by a well-defined membranous diaphragm which seemed to be attached around the interior of the wall of the test a little in front of its broadest portion. The true significance of the spherical body would, however, probably have escaped me, but for the occurrence of a hyaline crescentic space between its anterior convex part and the interior of the diaphragm, the convexity of which was also directed outwards.

Here then it became evident that a process of encystation precisely similar to that described by me as occurring in *Amoeba* ('Annals,' November 1863, p. 386) had taken place in a testaceous form, and that the test is neither the analogue nor the representative of the cyst of the naked forms, but must be regarded as an entirely distinct portion of the structure.

Now, how far the peculiar external features witnessed in the series of tests above alluded to may be associated with the decrease of the ordinary process of nutrition incident on encystation, and may thus tend to render the chitinous material of the test free to be acted on by purely chemical or physical forces, I am at present unable to say. It must not be forgotten, however, that the complete withdrawal of the body of the animal into the interior of the test, and its envelopment by the cyst, would necessarily prevent the diffusion of any portion of the sarcode-substance over the external surface of the test, and hence external influences would act directly on the test. But the repeated occurrence of similar tests with open apertures, and with the animal, at all events as yet, unimpeded by the cyst, seems clearly to indicate that the one set of conditions is not necessarily incompatible with the other. On the other hand, I am able to state that the singular characters presented by the tests and the process of encystation referred to are not confined to a

single variety or series of varieties, but pervade the whole group, inasmuch as I have met with tests of the mitriform series containing the encysted animal, the posterior third of which was still covered with large unmetamorphosed sandy particles, whilst the anterior two-thirds were studded with the elongated discs of figs. 28 & 29. In these tests the apertures were in every respect similar to the one figured at fig. 30 *b*, thus proving the transition from the common pyriform Diffflugian test to that variety in which all appreciable trace of mineral matter is lost. The above facts also enable us to account for the very common and provoking occurrence with which most persons who are acquainted with the freshwater testaceous Rhizopods must be familiar, namely, the frequent impossibility of getting the animal to emerge from the ball into which it rolls itself in the interior of the test.

These partially and wholly closed orifices are instructive, however, from another point of view, namely, from their proving that, even in the most mature state of the Diffflugian test, its outline is liable to change, and hence that the external mechanical agencies to which I have adverted in the case of *D. spiralis* may actually produce the duplicature of its test.

We now come to modifications in size. Were more cogent reasons wanting why mere measurements of the tests of the *Diffugiæ* should cease to be regarded as affording a basis for specific distinction, the facts already advanced to show how largely the whole of the external characters of the tests are influenced by outward conditions, which are themselves of the most fluctuating nature, would, as I conceive, amply suffice for the purpose. It is well known, however, that amongst the freshwater testaceous Rhizopods, the actual bodies of the animals occupy but a small and indeterminate portion of the chamber in which they are encased; and I presume no one will maintain the existence of a fixed ratio between the animal and its test. Should fission occur in *Diffugia*, as we know it does in *Amæba*, the existence of any such determinate ratio becomes still less admissible. It is therefore obvious that, in resorting to the measurement of the test as a criterion of the dimensions of the animal, the process must be altogether fallacious. But even amongst the higher tribes of the animal and vegetable kingdoms, notwithstanding the facilities these offer for ascertaining when the extreme limits are arrived at either in growth or age, size is not accepted as a test of specific unity or distinctness, unless it be accompanied by such structural or functional changes as can be shown to have exerted an influence in modifying it. But amongst the microscopic forms of life we have hitherto entirely failed to trace any constant indication by means

of which it is possible to determine whether a specimen under examination be a mature or an immature one. The frequent occurrence in the muddy deposits of effete tests of *Diffugia* and other testaceous forms throws no light on this subject; for there are no means of knowing whether such tests have been shed, according to a periodically recurring influence, or are merely left after the death of the occupant at a certain stage of its existence or through accident; and until such an indication is forthcoming, all specific distinctions based on mere size must therefore be valueless. These remarks apply, however, only to the measurements of such objects as the tests of the *Diffugidae* or other Rhizopods, and not to special organs, which, as they rarely vary to any great extent, whether in young or old individuals, may hence be frequently recognized by their dimensions alone. But even in such cases the aid afforded by measurement must continue to be counterbalanced so long as no uniform scale is adopted both in descriptions and figures, and a certain amount of calculation is necessary before we can arrive at the fraction which expresses what we desire to ascertain.

Of one fact I have had abundant opportunity of satisfying myself, namely, that the dimensions of the Diffugian tests, in like manner with their plan of growth and external characters, are modified to an extraordinary degree by the nature of the localities in which they happen to be found,—still water, with an abundance of food in the shape of minute Algæ and Infusoria, constituting the most favourable conditions; whilst variations in climate would seem to influence their growth and increase only in an indirect manner, namely, by increasing or diminishing the quantities of sustenance.

As stated in an early portion of these observations, I have met with representatives of every variety of the freshwater testaceous Rhizopods in each of the remote regions of the globe in which I have searched for them. It is well known that Diatoms, a group of organisms holding a position in the vegetable kingdom probably parallel to that held by the Rhizopods in the animal, are to be found in all climates. It is an interesting fact, however, and one which was somewhat unlooked for, that, under the conditions prevailing in high northern latitudes, the long-continued congelation to which the whole of the lower forms of life are annually subject seems to exercise no destructive effect; for not only are the freshwater Diatoms and Desmidi-ans* very plentiful, but also the whole of the freshwater

* In one locality in West Greenland, at an elevation of probably about 1000 feet above the sea, I obtained no less than twenty-six species and varieties of Desmidi-ans. Had my object been to collect this kind of organism, the number might doubtless have been largely augmented.

Rhizopods. Indeed, in point of number and variety, the latter were quite as abundant in Greenland as in Bengal; whilst the dimensions of the Greenland specimens were only inferior to those of some of the most highly developed varieties from the Gangetic Sunderbunds, to which I have already drawn attention.

I have now to speak of the last and certainly the least important of the modifications, namely, *colour*. My remarks on this head shall, therefore, be very brief.

Where the water in which the *Diffugiæ* occur is pure, and the vegetable matter contained in it not undergoing decay, the tests of these organisms, as might be inferred from the nature of the materials of which they are composed, are colourless. Sometimes mud or disintegrating organic matter adheres to the tests, and imparts a tint; but it must be obvious that this bears no relation to the animal or even to its test, and is therefore as variable a character as it is accidental. The chitinoid substance, however, which constitutes the basis of the matrix of the tests, generally speaking, exhibits a delicate sienna-tint; but sometimes it assumes a darker shade, and hence imparts a similar colour to the entire test. But, as this peculiarity pervades the entire series of forms, it furnishes no distinctive character. In some cases, as, for example, where *Diffugiæ* are collected in the red muddy deposits met with at Hampstead and elsewhere, the tint above referred to may be imparted from without; and since we know that in *D. Arcella* the young tests are colourless, whereas the mature ones gradually become brown, it is reasonable to suppose that the effect depends on age or exposure. But, for the reasons assigned, whilst the deepening of the colour of the test in *D. Arcella* enables us to form some estimate of the age of a specimen, in the other *Diffugiæ* the effect takes place to such a limited extent as to be unavailable for this purpose. It only remains to be mentioned that the colour of the animal within the tests varies, from the pale gray of granular sarcodæ to green or yellow or brownish red; but, in my experience, I have invariably been able to trace all the last-mentioned modifications of tint to the nature of the food which the organism has incepted.

My present limits do not admit of more than a cursory allusion to the *Euglyphidæ*. Indeed it would be impossible to give a satisfactory outline of their characters and relations without introducing several new and undescribed marine forms which would obviously be out of place in the present memoir. I shall confine myself, therefore, to stating that, since no doubts have arisen concerning the identity of the animal in the several genera and species into which the heretofore described members of this group have been subdivided, and mere differences in the figure

or surface-markings of the test cannot be regarded as denoting generic distinction, I am unable to perceive any valid ground for separating *Cyphoderia* (Schlumb.), *Diffugia Enchelys* (Ehr.), and *Lagynis** (Schultze) from the typical genus *Euglypha*.

The case is different, however, when we find that the test of one section of a subfamily is invariably chitinous, and of another as invariably siliceous. I accordingly deem it necessary to place *Cadium* (Bailey)—a form I have met with in abundance, and the true siliceous nature of whose test I can certify—in a distinct genus, along with the marine forms to which reference has been made.

Under this view of the general affinities of the testaceous freshwater Rhizopods, *Diffugia Arcella* may therefore be regarded as the connecting link between the *Diffugiidae* and *Euglyphidae*; whilst a very cursory examination of the forms of the latter subfamily, in which the general axis of the test and of its aperture are not coincident, will serve to show that this peculiarity is merely the counterpart of the obliquity that has already been shown to pervade the tests of the marsupiform series of the *Diffugiidae*, and, lastly, that the apical appendage which frequently makes its appearance in *Euglypha margaritacea*, and is carried to such an extent in one of the new oceanic forms—namely *Cadium caudatum* (Wall.)—as to constitute a tail-like organ several times the length of the body of the test, is in like manner merely the homologue of the apical appendage of *Diffugia acuminata* and the horned varieties of the globular series.

But to conclude. Assuming from the facts which have been advanced that the shape, material, size, and colour of the Diffugian tests furnish characters so singularly prone to accidental variation as to yield no trustworthy criterion of generic or even true specific distinctness, and recalling to mind once more that the animal is in every instance specifically the same, it appears to me impossible to arrive at any other conclusion than that the whole of the *subspecies*, as well as their intermediate varieties (widely though some of these appear to differ from others in external features), have not only been originally derived by direct descent from a single progenitor, but do still continue to be produced by direct descent from varieties which have become permanent, and may, one and all, still be produced from a common archetype under the varying conditions to which these lower forms of animal life are universally subject.

* My knowledge of this Rhizopod is derived exclusively from the description and figures published by its discoverer, Professor Schultze (Ueber den Organismus der Polythalamien, p. 56, taf. 7 & 8); and, allowing due weight to the difference of habitat, I can perceive no valid reasons for considering as only apparent the resemblance to *Euglypha curvata* (Perty) to which allusion is made in the definition.

In accordance with the views advanced, the whole of the Testaceous Proteina may be accordingly arranged as follows:—

Order PROTEINA.	Families.	AMEBINA.		Genus 1. <i>Diffugia</i> .	Subfamily. <i>Diffugiæ</i> .	Genus 2. <i>Cadium</i> (Bailey).	Genus 1. <i>Euglypha</i> (Duj.).	Subfamily. <i>Euglyphidæ</i> .	ACTINOPHYRYNA.
		Species 1.							
		<i>D. proteiformis</i> (Ehr.).							
		Subspecies 1. <i>D. mitriformis</i> (Wall.).							
		var. α . <i>D. acuminata</i> (Ehr.).							
		,, β . <i>D. spiralis</i> (Leclerc).							
		,, γ . <i>D. pyriformis</i> (Perty).							
		,, δ . <i>D. lageniformis</i> (Wall.).							
		Subspecies 2. <i>D. globularis</i> (Duj.).							
		var. α . <i>D. tuberculata</i> (Wall.).							
,, β . <i>D. aculeata</i> (Ehr.).									
,, γ . <i>D. corona</i> (Wall.).									
Subspecies 3. <i>D. Arcella</i> (Ehr.).									
Subspecies 4. <i>D. marsupiformis</i> (Wall.).									
var. α . <i>D. cassis</i> (Wall.).									

Genus DIFFLUGIA (Leclerc).

Characters. Animal a testaceous Amœban. Pseudopodia cylindrical or digitate. Test chitinous, or chitinous with addition of mineral matter.

Species 1. *D. proteiformis*.

Characters of test. Form of embryonic test subspherical, from $\frac{1}{2}$ th to $\frac{1}{3}$ th of the diameter in one direction being truncated and constituting the aperture. Form of mature test extremely variable.

Subspecies 1. *D. mitriformis* (Wall.).

Characters. Test mitre-shaped, more or less inflated at posterior extremity, and without any fixed ratio between its length and breadth.

Var. α . *D. acuminata*. Apex of test acuminate.

Var. β . *D. spiralis*. Anterior third of test bent back upon its body, so as to present a retort-shape*.

Var. γ . *D. pyriformis*. Shape varying from the pear- to the balloon-shape.

Var. δ . *D. lageniformis*. The same as the last, but with a lip everted in varying degrees. The most highly developed variety of this form, and one that might pass for the archetype of the Roman amphora.

* It is somewhat of a misnomer to call this form *spiral*: as already stated, the turn does not extend further than that of a retort.

Subspecies 2. *D. globularis* (Duj.).

Characters. Test more or less globular, from $\frac{1}{8}$ th to $\frac{1}{4}$ th being truncated and forming the aperture. Margin of the latter plain or crenulate. Test occasionally furnished with cornua, sometimes arranged symmetrically, sometimes the reverse; their number variable. Test occasionally depressed vertically and excentrically.

Var. α . *D. tuberculata*. Surface of test covered with subhemispherical nearly equal-sized elevations, which give it a mulberry-shape. In some tests there are corresponding hollows on the interior of the chitinous wall.

Var. β . *D. aculeata*. Test generally compressed excentrically, so that the aperture is also excentric. Margin of aperture generally inverted to some extent, but not always. Surface of test either furnished with a varying number of finger-like cornua, or plain. The cornua for the most part arranged in a half-circle round the posterior half of the test; but their position, as well as shape, is very variable.

Var. γ . *D. corona*. Test crown-shaped, furnished with from three to eight conical cornua placed around its posterior third. Margin of aperture regularly crenulate; number of crenulations variable.

Subspecies 3. *D. arcella* (Ehr.).

Characters. Test chitinous, rarely if ever presenting mineral matter on its surface, which is studded with regular but very minute hexagonal reticulations. Form presenting varying degrees of plano-convexity, the convexity at times amounting to that of a hemisphere; the aperture small, invariably occupying the centre of the plane surface, and its margin being more or less inverted.

Subspecies 4. *D. marsupiformis* (Wall.).

Characters. Test varying, in the side view, from that of a slightly excentric and depressed hemisphere to the pyriform outline, but with this peculiarity, that the aperture, as seen in this view, occupies a position on one margin of the pyriform figure, and extends from the centre to a point approaching the anterior or narrowest portion of the test. In the front view, the test is pouch-shaped. Margin of aperture markedly inverted. The mature test generally presents from three to six cornua arranged over its posterior third.

Var. α . *D. cassis* (Wall.). Merely a small and extreme variety of the marsupiform test, but rarely presenting the cornua.

On comparing the above arrangement and characters of the *Diffugiæ* with the figures in the accompanying plates to which attention is directed, there will, I presume, be but little difficulty in recognizing the points from which the predominant groups of varieties take their origin, and in tracing the gradations passed through by the most aberrant forms. I have deemed it preferable to represent the groups as diverging from

points equally distant from the common centre or archetype of the whole than as clustering round those points, for reasons which have been already given, but which it is perhaps desirable now briefly to recapitulate.

As repeatedly stated, the entire series of Diffugian tests are constructed by animals which, with no known exception, are *specifically* identical. *A priori*, therefore, there is nothing improbable in the supposition that the entire series, in their earliest condition—that is to say, when the chitinoid exudation, of which the test is entirely composed at that period, first makes its appearance around the sarcoblast—are identical in form. But we have no need to assume the fact, for observation would seem to prove it. If this be granted, only one other condition is essential to the establishment of the doctrine that the entire series, not only in time past may have descended genetically from a single progenitor, but, what is of far greater moment, that they may still continue to be developed from a typical form common to all,—this condition being that the chain of transitional varieties should be so unbroken, and that there should be such a *radiation of characters* at every step, as to render it impossible to detect a character or set of characters which can be said to belong exclusively to a solitary form.

Now this is precisely what observation teaches us when we study forms obtained from a sufficiently wide geographical range. For, as has been already shown, we not only then find that the unimportant gaps sometimes discernible between contiguous varieties are bridged over, but, if we note the differences in the external conditions by which the organisms are surrounded, we are able, generally speaking, to trace a relation between the varietal form and the agencies which have affected it.

But, although there is good reason to believe that these conclusions are correct, we must never lose sight of the fact, that under those peculiarities in the physical conditions which are inherent in every geographical area, and must therefore be regarded as constant in their operation, the repetition of certain varietal forms, to the exclusion of others, must also be constant. In this sense, but this sense only, can species and subspecies be established amongst the *Diffugidae*. *The animal does not vary; but it modifies the architecture of its habitation and the mineral material of which that habitation is in a great measure constructed, in obedience to local conditions, and in the manner best fitted to meet its requirements.*

It only remains for me to state that the universal distribution of these organisms, the ease with which they are obtained, their simplicity of structure, and the comparatively small number of types into which they seem to resolve themselves render them

singularly fitted to throw light on the laws which regulate the variation of species. For, however true it is that these lowest animal forms are prone to variation in an unprecedented degree, this cannot surely be advanced as a plea for assuming that the laws which govern specific variation amongst the higher orders of creation must necessarily be of a distinct nature.

Kensington, Feb. 19, 1864.

EXPLANATION OF THE PLATES.

PLATE XV.

This Plate is designed to show the order in which the four subspecies of *Diffugia proteiformis* arrange themselves around a common archetypal or embryonic centre; and their several varieties may be supposed to pass transitionally from one subspecific type to the other. It may be mentioned that none of the figures in either of these plates are diagrammatic, except the dotted half of figure 3 v in Plate XV.; and, with the exception of the central figure (fig. 1) of Plate XV., which is magnified about 800 diameters, that the whole of the other figures in both Plates are magnified from 200 to 300 diameters.

- Fig. 1.** Embryonic test of *Diffugia* from which the entire series take their origin, its diameter being about $\frac{1}{16}$ th of an inch, and the aperture formed by the truncation of from $\frac{1}{4}$ th to $\frac{1}{2}$ th of the diameter in one direction.
- Fig. 2.** The early state of the variety *D. mitriformis*, passing through 2 p and 2 q to the inflated form of the same variety, which then passes into the globular series (4 h), and through such forms as 2 a and 2 b to the extreme variety of this series, namely *D. lageniformis* (2 c). In this form the eversion of the lip of the aperture attains its maximum limit.
- Fig. 3.** Another young test of the mitriform series, passing in one direction into *D. spiralis* (3 v), in another exhibiting the various forms of *D. acuminata* (figs. 3 a, 3 b, 3 c), and in fig. 3 s merging into the variety called *D. pyriformis*.
- Fig. 4.** Early stage of the globular series. Fig. 4 h represents the typical subspecies *D. globularis*; fig. 4 g, the allied variety *D. tuberculata*; whilst fig. 4 a shows the occurrence of a crenulate aperture in the typical form, and, hence, the transition to the horned variety with the crenulate margin, *D. corona*. In this variety the number of horns and also of crenulations varies considerably. Finally, in fig. 4 k we observe the incipient obliquity in the axis of the globular form which suffices to render the position of the aperture excentric, and the horns met with in *D. corona*, but generally (as seen here) occupying only one-half of the test. This is the form referred to by Ehrenberg as *Arcella aculeata*.
- Fig. 5.** Early state of the oblique series (subspecies) to which I have given the name *D. marsupiformis**. Figs. 5 a, 5 d, 5 e are front and side views of the plain variety, showing great excentricity of the aperture, great vertical depression, and the inversion of the lip. Fig. 5 m, a horned variety of the same, closely approaching the aculeate variety of the globular series (4 k). Figs. 5 b & 5 c,

* *Marsupium*, a pouch.

front and side views of the extreme variety, *D. cassis**, in which it will be seen that the characters of the marsupiform series attain their maximum development. The well-marked *inversion* of the lip and the extreme excentricity at once denote this form as being the furthest removed from that in which the lip is everted, namely *D. lageniformis* (2 c).

Lastly, fig. 1 y represents *D. Arcella* as a subspecies springing directly from the embryonic form. In it we perceive the reappearance of the inverted lip, whereby it is allied to the marsupiform series, and the vertical depression which, in some of the plain globular forms, renders it so difficult to determine whether the specimen presenting it is an aberrant *D. Arcella* or *D. globularis*; whilst at fig. 1 z is given a member of the allied Actinophryan subfamily, the *Euglyphidæ*, related to *Diffugia Arcella* both in virtue of its purely chitinous test and the nature of the surface-marking in one of the species (*E. margaritacea*). *Diffugia Arcella* hence constitutes the connecting-link between the two subfamilies.

PLATE XVI.

- Fig. 1. Side view of a young specimen of the subspecies *D. globularis*; 1 a, front view, showing aperture.
 Fig. 2. Side view of somewhat advanced state of the same; 2 a, front view.
 Fig. 3. Side view of the early stage of the oblique or marsupiform series; 3 a, front view.
 Figs. 4 & 4 a. Same views of a still more advanced stage of the same.
 Fig. 5. Side view of horned variety of *D. marsupiformis*; 5 a, front view.
 Fig. 6. *D. cassis*, side view; 6 a, front view.
 Fig. 7. *D. mitriformis*, showing presence of the usual sandy granules on the posterior four-fifths of the test, whereas the anterior fifth is composed of chitinous cylinders. (This form was figured by me, but very imperfectly, in the 'Annals' for June 1863, Pl. 10. fig. 12.)
 Fig. 8. Two-horned specimen of *D. mitriformis*.
 Fig. 9. *D. pyriformis*, from Greenland, showing how completely the test is made up of frustules and valves of diatoms (*Eunotia* and *Tabellaria*).
 Fig. 10. Common form of *D. pyriformis*, showing moderately large sandy granules.
 Fig. 11. *D. acuminata*, made up of tabular mineral particles.
 Figs. 12, 12 a, 12 b, 13 a. Small specimens of mitriform and acuminate series. In fig. 12 a crystalline body has been added to the test.
 Figs. 13 & 14. Oblong variety, showing the apertural band.
 Fig. 15. *D. lageniformis*, showing incipient eversion of lip.
 Fig. 16. *D. lageniformis*, mature specimen, showing hyaline everted margin of the lip.
 Fig. 17. *D. globularis*, typical form, but made up of large sandy particles.
 Fig. 18. *D. tuberculata*, mineral matter consisting, in a great measure, of minute diatoms. The test of this form is mulberry-shaped.
 Fig. 19. *D. corona*, front view, showing crenulate margin of aperture; a six-horned variety.
 Fig. 20. A somewhat smaller four-horned variety; side view.
 Fig. 21. *D. globularis*, from Greenland, chiefly made up of minute diatoms.
 Fig. 22. Plain variety of *D. aculeata*, showing the transition from the plain globular to the oblique form, and the incipient inversion of the margin of the aperture.

* *Cassis*, a helmet.

- Fig. 23.** Six-spined variety of *D. aculeata*.
- Fig. 24.** Front view of *D. spiralis*. Test composed of chitinoid cylinders. 24 *a*, side view of the same. 24 *b*, a portion of a test, showing the intermixture, in some cases, of minute diatoms.
- Fig. 25.** *D. spiralis*. In this specimen, the test is entirely made up of ordinary mineral particles.
- Fig. 26.** *D. symmetrica*, showing the rectangular hyaline plates: *a*, form of aperture; *b*, a more compressed specimen, in which the aperture (*e*) is nearly closed; *d*, a few detached plates.
- Figs. 27** to 33 represent the series of forms exhibiting the transition from the ordinary mineral and chitinoid elements of the test to the evolution of the colloid discs. (See pages 231-234.)
- Figs. 34 & 35.** Varieties of *D. Arcella*.
- Fig. 36.** Puckered test of *D. Arcella*, which has hitherto been regarded as a distinct species, under the name of *D. angulata*.
- Fig. 37.** Front view of *D. Arcella*. In all these specimens the inverted lip is seen. Fig. *a* shows the invariably hexagonal pitting or reticulation of *D. Arcella*. (This can only be made out, however, in a mounted and crushed test, under a high power.)
- Fig. 38.** Young test of *D. Arcella*.
- Fig. 39.** This figure represents two *Diffugia* apparently united by their orifices in the manner which has been regarded by some writers as indicating "conjugation." The remarkable feature in the present example is, that the supposed conjugative act is being performed by individuals which, by the same writers, have been regarded as constituting distinct species.
- Fig. 40.** In this case, a specimen of *Amaba villosa* was seen to seize the pseudopodia of the *Diffugia*, and force the greater portion of its own body into the *Diffugian* test. After a time it again emerged, the villous organ, which had become concealed within the test, being the last portion to leave it.
- Figs. 41 to 45.** Varieties of *Euglypha*.
- Fig. 46 & 46 a.** Side and front views of *Euglypha Enchelys*.
- Fig. 47.** Bengal variety of same.
- Fig. 48.** *Euglypha margaritacea* (Stony Stratford). Fig. *a*, showing the manner in which the test is made up of minute chitinoid discs, so arranged that each one is united to those surrounding it by six equidistant connecting bands. In *Diffugia Arcella* the test almost invariably fractures through the hexagonal spaces, as seen in fig. 34 *a*. In *D. margaritacea*, the line of fracture as invariably traverses the spaces between the discs, proving that they are the thickest and strongest portions of the structure.

BIBLIOGRAPHICAL NOTICES.

The Natural History of Tutbury. By Sir OSWALD MOSLEY, Bart., D.C.L., F.L.S. *Together with the Fauna and Flora of the District surrounding Tutbury and Burton-on-Trent.* By EDWIN BROWN. London: John Van Voorst, 1863.

As Englishmen, we of course have a vested interest in all that concerns "bitter beer," and accordingly, as English naturalists, the physical peculiarities of the district around Burton-on-Trent, in which the best of that blissful beverage is brewed, should have a double interest to us. We must therefore briefly record our thanks

to Sir Oswald Mosley and Mr. Edwin Brown for the volume before us. Though we cannot accord it, notwithstanding the magnificence with which it has been "got up," a position in the highest class of local faunas or floras, yet the work contains a good deal that is of importance, and is on the whole most creditable to the worthy Staffordshire Baronet and his coadjutor.

We should be sorry to say one word to discourage the appearance of books of a character similar to this; but at the same time we must state that, in perusing it, we are reminded of certain short-comings which make themselves prominent in this 'Natural History of Tutbury.' One of the most remarkable features in the fauna of this limited district is the herd of the so-called "wild cattle" which still exists in the park at Chartley, where, it is stated, "the breed has been carefully preserved." Now the history of this herd, together with those that roam under the like conditions in Chillingham and other parks, deserves much more attention than our authors seem to have paid to it. We are told that the breed "is still kept in its original purity"—an expression which is open to at least two interpretations. Does it mean simply that common domestic bulls and cows are prevented from mingling their blood with the "wild cattle"? or does it mean that the careful preservation of the breed "in its original purity" is effected by the timely elimination of any calves which show a tendency to "sport" from an assumed standard of perfection? On neither of these points is any information given us. If the former signification be the correct one, we should have liked to know what remedy is provided against the certain evil consequences of breeding in-and-in among a limited number of animals; while, if the latter interpretation be attached to the expression, it would be of the greatest importance to naturalists to learn what are the general tendencies of any variations that from time to time may arise. That such variations were wont to occur in the red-eared Chillingham herd we have good evidence for believing*; and it is difficult not to suppose that the same may have been observed in the black-eared animals so long cherished at Chartley.

In the matter of birds, the most remarkable fact recorded in the present volume is that of the occurrence of a pair of the American Red-eyed Flycatcher (*Vireosylva olivacea*, Bonaparte)—the "Whip-Tom-Kelly" of our dis-united cousins—in May 1859, at Chellaston, near Derby. Such notices are always worth mentioning, but we are far from subscribing to the common opinion that accidental visitors of this kind should be enrolled in our lists. One circumstance, which, if Mr. Brown's surmises are to be trusted, is, to say the least of it, extremely curious, is the capture, on the bank of the canal near Burton, in 1857, of a living specimen of the European Freshwater Tortoise. It will be remembered that, in a paper read before the

* See the excellent paper by Mr. L. Hindmarsh in the first series of the 'Annals,' vol. ii. pp. 274-284. For the convenience of those who interest themselves in our British "wild cattle," we may take this opportunity of referring to two other notices in the same series, vol. iii. pp. 241 & 356.

Cambridge Philosophical Society*, and subsequently in this Magazine, Mr. Alfred Newton recorded the discovery of the remains of two individuals of *Emys lutaria* at Wretham in Norfolk (Annals, Sept. 1862, p. 224), in a peat-bog, from which it may be concluded, fairly enough, that this species, at an epoch by no means very remote, inhabited England. Mr. Brown, in consequence, is inclined to think that his "specimen may, after all, be truly indigenous," suggesting that it "may be one of the last surviving, if not the last survivor, of the British Chelonians." We sincerely hope that some further traces of the species may be found in the valley of the Trent, to the exploration of which we are glad to hear Mr. Brown is especially devoting himself, so as to justify the suspicions we have just mentioned.

The ichthyology of the district presents nothing out of the common way, unless we mention the complete naturalization of the *Cyprinus auratus*, which is stated to thrive and breed abundantly "in waters at Derby connected with some of the manufactory steam-engines," the increased temperature of which, combined with the grease that escapes from the machinery, furnish the necessary requirements of food and warmth.

Very long lists of the lower animals and of the plants make up the chief bulk of the volume. In many orders of the former, and in almost all of the latter, they are merely nominal, with the addition of the localities (of which an index is meritoriously added) where the species occur. In other cases some judicious remarks are interspersed, showing Mr. Brown's powers of acute observation. These we must leave, only mentioning here the admirable paper in the Appendix, by that gentleman, on the genus *Acentropus*. The nine plates which illustrate the work are nicely executed, Mr. Wolf's bird and Mr. Ford's reptile being of course entitled to special attention. And, to return to the subject with which we commenced this article, we may mention that Sir Oswald gives (page 7) a satisfactory reason for the excellence of Burton ale.

Homes without Hands; being an Account of the Habitations constructed by various Animals, classed according to their principles of Construction. By the Rev. J. G. Wood, M.A., F.L.S. London: Longman & Co. (In course of publication.)

Under the above-mentioned title that indefatigable compiler, the Rev. J. G. Wood, is issuing a work of which we are bound to say that the two Parts we have seen will not increase his credit as a naturalist. We do not like hazarding such an assertion without adducing something in support of our statement. What, then, are we to think of a man who speaks (part 2. p. 63) of a bird of the genus *Puffinus* as "allied" to the Puffin of English ornithology, the *Alca arctica* of Linnæus? While looking over Mr. Wood's lucubra-

* On the Zoology of Ancient Europe. London & Cambridge, 1862 (Macmillan).

tions, we feel like Garrick in Sir Joshua's celebrated picture, and hardly know whether to make choice of the tragic or the comic muse in criticising them. It may therefore be as well to say no more on the subject.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

June 9, 1863.—John Gould, Esq., F.R.S., in the Chair.

ON A NEW SPECIES OF PARRAKEET FROM CENTRAL AUSTRALIA.

By JOHN GOULD, F.R.S., etc.

The Board of Governors of the South Australian Institute having liberally forwarded for my inspection a selection from the ornithological collection made by Mr. Frederick G. Waterhouse during Mr. Stuart's late Exploratory Expedition into Central Australia, I have thought the matter of sufficient interest to bring these birds under the notice of the Society, the more so as it will enable me to make known through our 'Proceedings' a new and very beautiful species of Parrakeet pertaining to the genus *Polyteles*, of which only two have been hitherto known. Every ornithologist must be acquainted with the elegant *P. melanurus* and *P. barrabandi*, and I feel assured that the acquisition of an additional species of this lovely form will be hailed with pleasure. The specific appellation I would propose for this novelty is *Alexandra*, in honour of that Princess who, we may reasonably hope, is destined at some future time to be the queen of these realms and their dependencies, of which Australia is by no means the most inconspicuous.

POLYTELES ALEXANDRÆ, sp. nov.

Forehead delicate light blue; lower part of the cheeks, chin, and throat rose-pink; head, nape, mantle, back, and scapularies olive-green; lower part of the back and rump blue, of a somewhat deeper tint than that of the crown; shoulders and wing-coverts pale yellowish green; spurious wing bluish green; external webs of the principal primaries dull blue, narrowly edged with greenish yellow, the remaining primaries olive-green, edged with greenish yellow; under wing-coverts verditer-green; breast and abdomen olive-grey, tinged with vinous; thighs rosy red; upper tail-coverts olive, tinged with blue; two centre tail-feathers bluish olive-green; the two next on each side olive-green on their outer webs and dark brown on the inner ones; the remaining tail-feathers tricoloured, the central portion being black, the outer olive-grey, and the inner deep rosy red; under tail-coverts olive; bill coral-red; feet mealy brown.

Total length 14 inches; bill $\frac{1}{2}$; wing 7; tail 9; tarsi $\frac{1}{8}$.

Habitat. Howell's Ponds, Central Australia, $16^{\circ} 54' 7''$ S. L.

Remark.—This is in every respect a typical *Polyteles*, having the delicate bill and elegantly striped tail characteristic of that form. It

is of the same size as *P. Barrabandi*, but differs from that species in having the crown blue and the lower part of the cheeks rose-pink instead of yellow.

DESCRIPTION OF A NEW LIZARD OBTAINED BY MR. HENRY CARTER ON THE SOUTH-EAST COAST OF ARABIA. BY DR. J. E. GRAY, F.R.S., ETC.

Mr. Carter, so well known for his researches on the Foraminifera, Sponges, and Microscopic Vegetables of India, has lately sent us, with a series of his different species of *Spongilla* of India, three dried Lizards from the south-east coast of Arabia. One of these is a young *Uromastix*; the others belong to an aberrant form of Geckoid Lizards, distantly allied to *Phyllurus*, which has not before occurred to me, and which we certainly have not in the Museum Collection. It is peculiar for having its tail flattened horizontally, and fringed on each side with linear elongated spreading scales. The scales of the body are minute and uniform in size. I propose to call this genus

SPATALURA.

Head short, high. Nostrils oblong, transverse, on the upper surface of the nose, just above the labial shields. The eyes large, with a slightly projecting scaly ridge above, separated from the orbit, and forming a kind of shade. Ears open, deep. Labial shields distinct, few, about eight on each side; the rostral formed of a pair of shields; the chin-shield single, like the rostrals. Head, body, and limbs covered with uniform small granular scales; femoral and preanal pores none. Limbs elongate, slender. Foot elongate. Toes elongate, compressed, very slender; the upper side with distinct cross plates; the sole with granular scales. Tail slender, oblong, depressed, not so long as the body, covered above and below with scales similar to, but rather larger and more keeled than, those of the body, and with a fringe on each side of crowded, elongated, slender, linear scales, with some smaller ones at their base.

This genus differs from all the other naked slender-toed Geckoid Lizards in the form of the tail; and it is also remarkable among these animals for the uniform granular character of the scales, the height of the head, and the slenderness of its legs and feet, which give it much the external appearance of some of the species of *Anolis*, which are without any dorsal crest; but it is easily known from them by the large-sized open eyes, destitute of any eyelids.

SPATALURA CARTERI.

Pale grey (dry from spirits) above, whitish beneath; belly of one (male?) orange; central part of the back, forearm, and shanks varied with square white spots; sides with numerous narrow, black-edged, yellow streaks, which are closer together and more visible on the hinder part of the body.

Hab. Island of Massera, on the eastern coast of Arabia.

I have great pleasure in naming this beautiful species after Mr. Ann. & Mag. N. Hist. Ser. 3. Vol. xiii. 17

Carter, who has laboured so successfully in extending our knowledge of many obscure Indian animals and plants.

Mr. Carter observes, "The two Lizards of a lavender or light lead-colour, with nearly invisible brown spots or lines, were caught in the island of Massera, which is about forty miles long, barren, and situated close to the shore of the south-east coast of Arabia, towards its easternmost end.

"The tail of one has dropped off. To the best of my recollection, it was not bushy or crested, like that of the one which remains on; and that at the time made me think the latter was the male, and the other the female of the species.

"It is just possible they may be new; for Massera is little known, and I think we (the surveying people) were the first white men who were ever on the island."

Most probably the tail of the second specimen, which was lost, might have been reproduced, and thus without the lateral fringe.

"The channel on the inner side of the island swarms with the Edible and Hawk's-bill or Turtle-shell Turtle; and the island is bestrewn with the bones of the former: for the inhabitants are all mere brutes (Anthropophagi and Ichthyophagi)."

This genus of *Geckotidæ* has many characters in common with the *Agamidæ*. Like *Eublepharis* it has a large circular pupil to the eye, and in this respect they form together an aberrant group of the family. In both these genera the pupil is large as well as circular. It is also peculiar, among the Geckoids, for the scales being all of a uniform size and character; but this is found in a few other species, such as *Boltanea sublaevis*, where the minute sublenticular scales are often almost entirely wanting.

"The Prickly-tailed Lizard, of a light-brown colour, was caught in or close to the town of Makulla, a port on the south-east coast of Arabia.

"I regard it as the young of a species just like it, which grows to a foot or more in length, on the coast mentioned."

This is very nearly allied to *Uromastix spinipes*; but unfortunately the specimen is too young and not in a sufficiently good condition to determine if it is absolutely the same.

OBSERVATIONS ON AUSTRALIAN TREE-FROGS LIVING IN THE SOCIETY'S MENAGERIE. BY DR. A. GÜNTHER.

The only Australian Batrachian which, to my knowledge, has until lately been exhibited in the Society's menagerie is *Pelodryas cæruleus* (*Hyla cærulea*, White), a specimen of which, almost unobserved, lived there for two or three years. In the beginning of the spring of this year, however, an opportunity was taken of procuring eight specimens, which were imported by a collector from New South Wales, and which belonged to four species, viz. to *Pelodryas cæruleus*, *Hyla Peronii*, *Hyla Krefftii*, and to an apparently undescribed form, which we shall name *Hyla phyllochroa*. Having had an opportunity of observing these for some time in the Gardens in the

Regent's Park, as well as at my own house, I may make the following remarks. In general, I was surprised to find a great similarity in their habits with those of our common European Tree-frog. They sleep during the day, squatting in a corner, generally selecting a place in which they are hidden from view, but easily roused on the approach of some insect, which they seize with their tongue. When the prey is large, or when they have accidentally seized a small piece of wood, &c., together with the insect, they use their fore foot to push the insect into the mouth, or to remove the object which is unfit for food. They never enter the water during the summer months, and tried to escape from a tank when put into it. They leave their hiding-places towards dusk, becoming very lively, apparently less with the object of obtaining food (which they can only procure by quietly remaining in wait for it) than with that of enjoying themselves; and *Pelodryas caeruleus*, which is endowed with a voice, indulged every evening in a musical performance. They became more quiet after midnight, and at sunrise they had settled down at some resting-place, sometimes one individual choosing the same place for several consecutive days. They preferred bluebottle flies to every other insect, and never touched ants or black beetles. *Pelodryas caeruleus* feeds freely on meal-worms when other food is scarce; but they are frequently vomited, and I doubt whether these frogs could be kept in good health if restricted to this particular kind of food. In all these points the Australian species mentioned agree with the European Tree-frog, and I need hardly say that they as easily climb smooth surfaces, glass, &c., as the latter species.

Pelodryas caeruleus, White (Günth. Batr. Sal. pl. 9. fig. B).—The natural colour of this species is a light grass-green, which, when the animal is kept in the dark or in a very wet place, changes into dark sap-green; roundish yellowish-white spots are sometimes scattered on the sides. I have mentioned above that it has a voice, which is a kind of grunting, somewhat resembling that of *Rana esculenta*, but lower. I must remark, however, that the two examples in the menagerie, a male and female, are evidently not full-grown; and I was rather surprised to hear a voice at all from the male, as in *Hyla viridis* the vocal sac and the voice are not developed before the individual has attained to maturity and to its full size. The hind limbs are comparatively short, and therefore this species cannot make such wide jumps as the true *Hyla*. I could not observe any secretion from the parotid glands, which are so much developed in full-sized individuals, but which are scarcely perceptible in our specimens. These Frogs soon became familiar, especially the male, which, when I went to feed them, used to approach and to watch the opening through which I introduced the flies into their cage.

Hyla Peronii, Bibron.—This species is very remarkable on account of the change of its colours. When awake, it is brownish olive, covered all over with blackish-brown spots, between which small green dots are scattered; the anterior and posterior sides of the thigh and the loin are bright yellow, with irregular reticulated black spots. The pupil is open, horizontally elliptic, and crossed by a very distinct

blackish vertical band. When asleep, the dark spots disappear entirely, the ground-colour becomes lighter, the green dots are very indistinct, and the numerous tubercles with which the skin is covered are whitish at the top. The pupil is contracted into a minute square opening, from which four black lines radiate.

This species is very nimble in its motions, making great leaps when pursued, and darting after flies from 8 to 10 inches distant; but it frequently misses its aim in these attempts. I have heard it emit a sound, but only when it was caught, and which I cannot otherwise describe than by comparing it with that emitted by *Hyla arborea* under similar circumstances.

Hyla Krefftii.—A single specimen of this species, lately described by myself*, being in the collection, I am enabled to give a description of the natural colours. A broad brown band commences between the eyes and extends to the vent, occupying the back almost entirely; it is lighter along the middle; another dark-brown band descends obliquely from the eye to the humeral pit; the sides are light reddish olive, and covered with minute brown dots, like the back. The hind part of the thigh is of a beautiful purple colour. This species changes its colours but little; but they appear darker and the markings more intense when the animal is awake than when asleep. Our specimen is much less greedy and less active than *H. Peronii*, although it is not less slender, and makes leaps as long as the other species; it selects its hiding-place on the ground below some stones. I have not heard any voice from it; but I am not certain about its sex.

Hyla phyllochroa, n. sp.—Snout rather short, broad, with the canthus rostralis angular. The vomerine teeth form two very small groups, situated behind the level of the hinder edge of the inner nostrils. Tympanum distinct, much smaller than the eye. Tongue scarcely notched behind. Perfectly smooth above; belly granular; a fold across the chest. Fingers one-fourth webbed; the membrane between the toes does not extend to the terminal disk. Uniform green above, white below; a very narrow, slightly prominent black line, edged with yellow superiorly, runs from the eye, above the tympanum, to the side of the body, where it is lost.

Besides the living specimen in the Society's menagerie, I have examined three others in the British Museum (two from Sydney, received through Messrs. Cuming and Krefft, and one from Errumanga, new). This species possesses the faculty of changing its colours only in a slight degree; it is generally of a uniform light sap-green, which, under certain circumstances, becomes darker. I have not heard a voice from it. Those in the British Museum are females; the largest has the ovaria fully developed, and measures 17 lines from snout to vent; the hind leg 29 lines.

NOTICE OF A NEW SPECIES OF BATAGUR FROM NORTH-WESTERN INDIA. BY DR. J. E. GRAY, F.R.S., F.L.S., ETC.

Sir Andrew Smith, M.D., lately sent to the British Museum,

* Ann. & Mag. Nat. Hist. 1863, xi. p. 28, pl. 4. fig. C.

with some other interesting reptiles, a young specimen of *Batagur* from the River Chenab, which seemed different from any that I had hitherto seen; but I was disinclined to describe a species on a single specimen in a young condition.

Dr. Günther, the other day, found in a collection that was offered for sale at Chatham a specimen of a *Batagur*, which he thought was different to any that we had in the Museum; and I have little doubt that this specimen is an older and probably nearly adult specimen of the same species as that sent to the Museum by Sir Andrew Smith. I therefore proceed to give a short notice of them.

The species is intermediate in character between the sections *Kachuga* and *Pangshura*. It has the elongated rhombic fourth vertebral plate of *Pangshura*; but the feet are very broad, the toes long, the claws elongate; the back is evenly rounded, and the second vertebral plate broad and six-sided, as in *Kachuga*.

BATAGUR SMITHII.

Shell oblong above, rather wider and very slightly dentated behind; the back regularly rounded, interruptedly and subnodosely keeled. The three first vertebral shields oblong; the first rather urceolate; the second subhexangular, rather broader than long; the third narrower, nearly twice as long as broad, with a prominent keel on the hinder half; the fourth very long, tapering, and very narrow in front, square, truncated, and keeled behind; nuchal shield small; marginal shields broad, the sixth and tenth with the upper edge produced upwards; the sternum flat, slightly keeled on the sides, white, it and the underside of the marginal shields blotched with blackish; the gular plate triangular.

Hab. North-western India: Punjab; "River Chenab, 3rd December, 1848."

The younger specimen is not so strongly keeled; the second and third vertebral plate are rather broader compared with their length, and the fourth is more nearly lozenge-shaped.

This species, which will be figured in Dr. Günther's 'Reptiles of British India,' which he is preparing for the Ray Society, may be known from *B. lineata*, which it most resembles, by the shell being more ovate, and by the form of the fourth vertebral plate, which is so contracted in front that it is not wider than the keel of the third vertebral shield.

I have named this species after my excellent friend Sir Andrew Smith, the late Director-General of the Army Medical Board, an encourager of science, and very accurate and industrious herpetologist and traveller.

DESCRIPTION OF A NEW *GEOCLEMYS* LATELY LIVING IN THE GARDENS OF THE ZOOLOGICAL SOCIETY. BY DR. J. E. GRAY, F.R.S., F.L.S., ETC.

Some time ago the British Museum received a *Geoclemys* from the Zoological Society that had been living in the Gardens, which we have preserved in spirits. Having occasion to examine it the

other day, in connexion with some other *Terrapens* more lately received, it appears to be distinct from any other that we have, and from any that I can find described. Unfortunately it was not accompanied by any account whence it came, so that I cannot give its habitat.

GEOCLEMYS CALLOCEPHALUS.

Shell oblong, convex, bluntly keeled; dark blackish brown; shields thin, slightly ringed, the margin nearly entire; vertebral shields about



as long as broad, the second and third rather longer; nuchal shield short; the marginal shields broad, the ninth rather higher than the rest; underside of these yellow, not spotted or ringed; the sternum convex, rather bent up in front, broadly truncated before, and behind pale yellow, more or less blackish on each side of the central line. The upper part and side of the neck pale; the upper part of the legs closely speckled with minute black dots; the front of the fore legs pale, with some black spots on the edge of the large flat scales which cover this part; the front toes short, coalesced nearly to the claws, with a few rather narrow angular shields on the upper surface; the palms covered with moderate scales, and with a cross row of five large, nearly uniform-sized, squarish shields on the hinder part of the wrist; the hind legs covered with small scales; the hind foot broad, the toes short, and coalesced like the front one, but with rather larger shields above the soles, with moderate-sized scales, and with some large triangular shields at the hinder part of the heel, in two or three series; the chin and throat white, spotless; the head rather flattened; the eyes lateral; upper jaw slightly notched in front; the crown of the head (in spirits) pale, with three black-edged white broad streaks concentric one within the other, and diverging parallelly towards the occiput, where they are lost among the black specks; cheek with five or six narrow black horizontal lines, the lower bending up to the tip of the ears; there is an obscure black streak from the nose to the middle of the orbit, and a narrow streak near the upper edge of the upper jaw, and some black oblong spots on the lower side of the ear and temple, which may be more distinct in the living specimen.

Hab. Unknown; perhaps China.

This species in several respects agrees in form and appearance with *Emys chinensis*, of which, as is shown by the specimen brought by Mr. Swinhoe to this country, the Tortoise described by me as *Emys Bennetti* is only the adult. It is at once known from *E. chinensis* by the minutely speckled body and the bands on the head, and by

the under surface of the marginal shield being destitute of any rings or spots. The head and neck of *E. chinensis* are covered with uniform narrow black lines, which on the chin and throat form circles. *E. chinensis*, like *E. Bealei*, is a true *Emys*, with slender, distinctly developed toes and fingers, which are united by a web to the claw,—*E. chinensis* having moderate-sized thick scales in the front of the fore legs, with some larger and broader scales, or small shields, scattered among them, and *E. Bealei* small granular scales on the legs, with three or four broad, thin, lunate, band-like shields across the front of the fore legs.

In the black speck on the neck and body, and the ornamental lines on the head, this species has some affinity to *E. pulcherrima*, described and figured in my Catalogue from a very young specimen, said to come from Mexico. But this habitat is doubtful, as some other animals, procured from the same person and said to be from the same habitat, have proved to be from other countries. This species also, as far as can be judged from the dry state of the specimen, may probably be a *Geoclemys*.

DESCRIPTION OF A NEW SPECIES OF MACRUROUS DECAPOD
CRUSTACEAN BELONGING TO THE GENUS PENÆUS, FROM
THE COAST OF PORTUGAL. BY JAMES YATE JOHNSON,
CORR. MEM. Z. S.

PENÆUS BOGAGEI, sp. n.

The subcylindrical carapace is less than half the length of the abdomen, including the caudal segment, and is excavated at the middle of the posterior margin. A median crest commences near the posterior margin, and projects in front as the rostrum, which is more than half the length of the carapace. This rostrum extends much beyond the eyes, but not quite so far as the distal extremity of the peduncle of the superior antennæ. It has a slight sigmoid flexure, is compressed, and is marked at each side with two low crests and two grooves. Its lower edge is simple; but its upper edge carries eight small teeth, the first of which is over its base, and the last some little distance from its anterior extremity. There is a fringe of hair at the lower edge posteriorly. The median crest of the carapace carries a single tooth, which is distant from the anterior margin about one-third of the length of the carapace. At each side of the carapace, a little in front of this tooth, there is a large tooth or small spine, in the neighbourhood of which there is a depression. Above the spine a narrow and somewhat sinuous groove extends nearly the whole length of the carapace. A little behind each anterior angle of the carapace there is another spine smaller than the one last mentioned. The anterior margin of the carapace is deeply excavated at the base of the inferior antennæ, and between this excavation and the base of the ocular peduncle there is a strong sharp tooth or spine; whilst over the base of the eye-stalk there is a minute angular projection, hardly to be called a tooth. The eye is large, being both broader and longer than its stalk.

The superior antennæ have the basal joint of the peduncle broad and much hollowed to receive the eye, and its inner border carries a short lamellar appendage. Each has two filaments with thickened bases, of which one is nearly twice as long as the other, and the longer has a length nearly equal to that of the carapace exclusive of the rostrum. The basal joint of the inferior antennæ is short and thick, and it has a small emargination in front on the upper side. Their palps are large, extending very nearly as far as the rostrum, and they are shaped like the quarter of an elongated ellipse; but the thick outer margin curves slightly inwards, and projects in front as a short tooth. The inner margin is fringed with hair. The filament is longer than the total length of the Crustacean, including the rostrum.

All the feet are slender, and the first three pairs are two-fingered, with ovate hands, the rest being monodactyle: none are multiarticulate. The order of their length, commencing with the longest, is 5, 4=3, 2, 1; the third and fourth pairs reach beyond the eyes; the first pair has a fringe of hair at the under edges of all the joints, and the second and third joints each carry a spine at the distal extremity of the underside. The first pair of pedipalps is long, slender, and pediform; they extend beyond the eyes.

The abdomen is subcompressed in front, much compressed behind, and the anterior five segments are furnished with large and prominent false feet, each terminated by a pair of narrow flexible plates fringed with hair, of which the outer one is longer; the basal joint is shorter than either. All the segments have their inferior margins fringed with hair. The fourth, fifth, and sixth segments possess a median keel, which terminates posteriorly with a small sharp tooth; and the sixth segment has in addition a small tooth at each posterior angle. The posterior margins of the fourth and fifth segments have a small notch at the middle of each side. The seventh or caudal segment is about as long as the sixth, which is longer than any of the preceding segments; it is narrow, terminates in a point, and is armed with a small spine at each side near the posterior extremity. The lateral plates are narrowly oval and fringed with hair; both pairs extend beyond the seventh abdominal segment, but the outer plates are larger than the inner, which latter have a longitudinal median groove on the upper surface between two low crests. There is also a groove on the upper surface of the exterior plates; but it is not in the median line, and it terminates at the outer margin not far from the posterior extremity of the plate. At this place there is a small sharp tooth, and here commences a low crest which crosses the plate with a curve and divides it into two unequal portions. The common basal joint of these plates has a small sharp tooth at its postero-exterior angle.

Large quantities of this *Penæus* are taken at the mouth of the Tagus during the spring and summer months; and it frequently appears on the breakfast-tables of the hotels in Lisbon, where indeed it first attracted my attention. It is known in the market under the name of "*Camarão*," i. e. Prawn. The living Crustacean has a pale

red colour, which deepens on being boiled into the pinky red of our Prawn. It may be readily distinguished from *Penæus Caramote*, which has also been taken on the coast of Portugal, by the single crest on the carapace, by the absence of teeth from the underside of the rostrum, by the presence of a spine near the anterior lateral angles of the carapace in addition to the spine between the bases of the inferior antennæ and the eye-stalks, by the much greater length of the filaments of the superior antennæ, which in *P. Caramote* are not more than a fourth of the length of the carapace minus the rostrum, by the absence of spines from the two basal joints of the second and third pairs of legs, and by the presence of a single spine, in place of three, at each side of the caudal segment of the abdomen.

Examples having a total length, including the rostrum, of $5\frac{1}{4}$ inches, and a carapace with a width of rather more than half an inch, are not uncommon; but the finest specimen I have seen was kindly presented to me by Dr. J. V. Barbosa de Bocage, Director of the Royal Museum of Lisbon. This specimen, which is now in the British Museum, has the following dimensions:—

	inches.
Total length from tip of rostrum to end of caudal plates	$6\frac{6}{8}$
Rostrum, length	$1\frac{1}{8}$
Carapace, without rostrum, measured at the side, and including the frontal spine	$1\frac{1}{8}$
Carapace, width	$1\frac{1}{8}$
Abdomen, length to the tip of the caudal segment ..	$3\frac{1}{8}$
First legs, length	$1\frac{1}{8}$
Fifth legs, length	$2\frac{1}{8}$
Outer pedipalps, length	$1\frac{1}{8}$

DESCRIPTION OF A NEW SILICEOUS SPONGE FROM THE COAST OF MADEIRA. BY JAMES YATE JOHNSON, CORR. MEM. Z. S.

Order SILICEA, Bowerbank.

DACTYLOCALYX, Bowerbank, Phil. Trans. 1862.

Skeleton siliceo-fibrous. Fibres solid, cylindrical. Reticulations unsymmetrical.

DACTYLOCALYX BOWERBANKII, sp. n.

The skeleton of this sponge is composed of an inelastic network of silex of a dense and irregular structure. Under a power of sixty diameters a slice of it resembles the crumb of bread, without any trace of the structure resembling spoked wheels, such as is exhibited by a siliceous sponge preserved in the Museum at Paris under the name of *Iphiteon*,—a similar structure being also seen in the pith of some water-plants. The fibre is smooth, but somewhat nodulous. The skeleton is covered with a rather thin crust, of a close texture, without conspicuous orifices, and this crust abounds with large spicula of the form denominated “spiculated patento-ternate” by Dr. Bowerbank in his memoir read before the Royal Society in 1857; and some of them are developed into the dichotomo-patento-ternate

form, such as is represented in fig. 48 of plate 23 of the 'Philosophical Transactions' for that year. But in the sponge under description the shaft is not prolonged through the common base of the triradiating branches, and the second division of these branches is much longer than the first or third; the third division, or ultimate branchlets, are pointed, and not in the same plane with each other or with the preceding portion of the branch, just as in the case of the spiculum represented in the figure already referred to. The shafts of the spicula project into the reticulations of the skeleton. In addition to the large spicula, the dermal membrane abounds with minute elongato-stellate spicula having short stout cylindrical radii; and a very few of these are dispersed in the interstitial membranes beneath the dermis. On the surface of the skeleton, immediately beneath the dermis, there is an abundance of long acute spicula, disposed either singly or in fasciculi which are often parallel with each other. These acute spicula are not found in the deeper interstitial portions of the sponge, but a few long, very slender, and flexuous spicula are occasionally to be found there. No sexradiate spicula could be detected, nor were any gemmules observed.

The single example of this sponge which has been obtained was brought up from deep water off the coast of Madeira. It was attached to a rock or stone by the middle portion of the underside. Its colour is white; and although its texture even when fresh was firm, the finger-nail easily made a permanent impression upon its surface. The animal matter was in comparatively small quantity. When a portion of the sponge was immersed in nitric acid it acquired a yellow tinge. The shape is that of a concave disk or shallow cup, with the border undulated into a few strong folds, some of which rise two or three inches above the rest of the surface. In one instance the opposite sides of a fold have grown together. The general appearance calls to mind a large fungus such as is sometimes seen attached to the trunk of an old tree. It measures fourteen inches across in one direction, in another twelve inches, and it has a thickness varying from half an inch to nearly an inch.

Dr. Gray has had the kindness to let me examine the half of a siliceous sponge which came into his possession from Mr. Stutchbury, who obtained it, I understand, from Barbadoes, and described it in the 'Proceedings of the Zoological Society,' 1841, p. 86, under the name of *Dactylocalyx pumiceus*, in these words:—"Sponge fixed, siliceous; incumbent canals uniform in size; excurrent canals large, forming deep sinuosities in the outer surface, radiating from the root to the outer circumference." Comparing the sponge now described with Dr. Gray's, I find in mine no well-marked system of incumbent and excurrent canals with large orifices, as in the Barbadian sponge, which latter is of a much more open and porous texture, and besides exhibits in its present state not the slightest trace of a skin.

Dedicated to Dr. J. S. Bowerbank, F.R.S., who has devoted his attention for many years to the Spongiadæ, and who is now giving to the scientific world, through the medium of the 'Philosophical Transactions,' the results of his important investigations.

Nov. 10, 1863.—E. W. H. Holdsworth, Esq., F.Z.S., in the Chair.

The Secretary read several communications addressed to him by Dr. George Bennett, F.Z.S., respecting the arrival of specimens of *Didunculus strigirostris* in Sydney. The first of these, dated June 18th, 1863, contained the following notes on this subject :—

“In the early part of June 1863 a living *Didunculus* was brought to Sydney by Mr. J. Williams from Apia, Upolu, one of the group of the Navigator Islands; and on the 15th of June and the following days I had several opportunities of examining the bird. At first it seemed rather shy and wild, but afterwards it became more tame, and I could examine it without its manifesting any fear. It is about the size of a Nicobar Pigeon (*Caloenas nicobarica*), but rather bulkier and rounder in form. Its plumage was not in good condition, owing to its having been recently confined in a cage on board ship, but it appeared healthy. This specimen, I should say, was a young bird with immature plumage, and the tooth of the lower mandible not yet developed. When I first examined it, the bird showed its fear by occasionally uttering some rapid ‘coos’ and by fluttering in its cage, but it subsequently became quite tame. It was captured, on the Island of Upolu, after being wounded in the wing, and was sold by a native to Mr. Williams. It has now been in captivity about nine months, and is kept in a cage, which is merely a box with rails in front, like a hen-coop. Here it can run on the floor, or sit on a low perch, or conceal itself in the corners, as it is particularly fond of doing, where, with its dark-coloured plumage, it cannot readily be distinguished. When disturbed, it would move gently and timidly across the cage, affording an excellent opportunity to the observer of examining it. It is a stupid-looking bird, and has no particular attraction, except the anomalous and extraordinary form of the beak, which cannot fail to excite the attention of the most ordinary spectator. The only sound it utters is the quick ‘Coo-coo-coo,’ to which I have already alluded, the beak being always a little open when the notes were emitted. The whole of its plumage is of a chocolate-red colour, deeper in tint on the back, tail, and the primaries and secondaries of the wings, the throat, breast, and wing-coverts being barred with light brown. The upper part of the head was rather bare, from the feathers having been rubbed off; but what remained were of a dark slate-colour. The base of the beak is orange-red, and the rest of the mandibles of a yellowish hue. The tarsi are not feathered; and the legs and feet are of a bright orange-red, similar in colour to those of the Kagu. The irides are dark reddish brown, and the cere round the eyes is flesh-colour. The bird is fed upon boiled rice, yams, and potatoes.”

Dr. Bennett's second letter, dated July 18th, contained the following additional particulars :—

“I have to add to my account of the bird sent last mail that this bird was captured within five miles of Apia, Island of Upolu; so that the bird is not yet quite extinct in that island, as has been

supposed even by the resident missionaries. It is very fond of the mountain-plantain, upon which it has often been found feeding in its wild state."

A third letter from Dr. Bennett (dated August 19th) contained the gratifying intelligence that a second specimen of the *Didunculus* had reached Sydney, and that Dr. Bennett, with his usual liberality, had purchased the pair of birds, and was intending to send them home to the Society the first convenient opportunity. The following extracts were read from this last communication:—

"Since my last letter another living specimen of the *Didunculus* has been brought to Sydney, by the Rev. Mr. Rigg, who procured it from a native on the Island of Savaii. This I have reason to believe is the identical bird that Mr. Trail, at the instigation of Mr. O'Hea, endeavoured to procure for me, as, in reply to Mr. Trail's inquiries respecting the bird, the native informed him it had just been sold to a European on the other side of the island. On the day after the arrival of the vessel, I went on board and saw the bird, which is a much finer specimen than the one in the possession of Mr. Williams. It appears to be fullgrown and in adult plumage, the head, neck, breast, and upper parts of the back being of a glossy greenish black; back, wings, tail, and under tail-coverts a deep chocolate-red colour; but I consider that the bird has only recently been changing its plumage, and that the present dark-green feathers will become more brilliant, and the chocolate-red colour of a still brighter hue. The legs and feet are of a bright red colour, and the claws yellowish white. The mandibles are of an orange-red colour, shading off near the tips to a light yellow. The cere round the eyes is also of a bright orange-red colour; eyes brownish black. It is agreed by every one with whom I have conversed, who have resided at the Navigators' Islands, that the *Didunculus* is nearly extinct, both from being eaten by the natives as well as from the cats, rats, and other vermin, and that most of the other Ground-Pigeons are following its fate from the same causes. The possessor of the last bird says he has never observed the bird to drink water since it has been in his possession. Its food at that time consisted of boiled yams, but it will eat bananas, apples, bread, and boiled potatoes. The lower mandible has the tooth well developed. This bird was very tame, and was eating some boiled yam very voraciously during the time I was inspecting it, bolting down very large pieces.

"This morning I examined both birds. They are evidently moulting, and the younger bird has grown very much since I last saw it, and is becoming now a much larger bird than the last arrival; from this I am inclined to think they may prove male and female. I this afternoon purchased these birds, after some difficulty. It is my intention to send them by Mr. Broughton of the 'La Hogue,' unless some very good opportunity occurs in the mean time, which is not probable. Our Acclimatization Society of New South Wales are desirous of purchasing one or both, and to send them to your Gardens in their name; and I have, at all events, secured them for

myself at present, but will let you know how they are progressing every mail. I hope these valuable birds will reach you alive; but should they die, I shall arrange to have them preserved in spirits, as the bodies, from their rarity, are also, I am aware, very valuable.

"We purchased last month a fine specimen of the 'Lyre-bird' (*Menura superba*), intending to send it to the Zoological Society. It was captured in the Illawarra district, and was a male; and the beautiful 'lyre'-shaped tail was fully developed, and the whole of the plumage in excellent condition. It only survived a few days, -showing how difficult it is to keep these birds in captivity."

MISCELLANEOUS.

On a Function of Roots.

HENRICI has made some ingenious and interesting observations on the function of roots in supplying water to the plant, and on the development, under certain conditions, of special roots destined for this purpose. It is a matter of not infrequent occurrence that plants send roots into wells, cisterns, drain-pipes, &c., where they exist in continual contact with a body of water. In drain-pipes the roots of plants usually considered to be free from aquatic tendencies, such as rape (*Brassica*), sometimes accumulate to a surprising extent. Henrici surmised that the roots which most cultivated plants send down deep into the soil, even when the latter is by no means porous or inviting, are designed especially to bring up water from the sub-soil for the use of the plant. The following experiment was devised for the purpose of establishing the truth of this view.

On the 13th of May, 1862, a young raspberry plant, having but two leaves, was transplanted into a large glass funnel filled with garden-soil, the throat of the funnel being closed with a paper filter. The funnel was supported in the mouth of a large glass jar, and its neck reached nearly to the bottom of the latter, where it just dipped into a quantity of water. The soil in the funnel was at first kept moderately moist by occasional waterings. The plant remained fresh, and slowly grew, putting forth new leaves. After the lapse of several weeks, four strong roots penetrated the filter and extended down the empty funnel-neck, through which they emerged on the 21st of June, and thenceforward spread rapidly in the water of the jar. From this time forward, the soil was not watered any more, but care was taken to maintain the supply in the jar. The plant continued to develop slowly; its leaves, however, did not acquire a vivid green colour, but remained pale and yellowish; they did not wither until the usual time late in autumn. The roots continued to grow, and filled the water more and more. Near the end of December the plant had from seven to eight leaves, and a height of 8 inches. The water-roots were vigorous, very long, and beset with

numerous fibrils and buds. In the funnel-tube the roots made a perfect tissue of fibres. In the dry earth of the funnel the roots were less extensively developed, yet exhibited some juicy buds. The stem and the young axillary leaf-buds were also full of sap. The water-roots being cut away, the plant was put into garden soil, and placed in a conservatory, where it grew vigorously, and in May bore two offshoots.

The experiment makes it quite certain that plants extend a portion of their roots into the subsoil chiefly for the purpose of gathering supplies of water.—*Henneberg's Journal für Landwirthschaft*, 1863, p. 280 *et seq.*

On the Air of the Swimming-Bladder of Fishes.

By A. MOREAU.

The author in the present paper describes the conditions under which the amount of oxygen in the swimming-bladder of fishes may be augmented. In the Physostomous fishes the duct of the swimming-bladder enables the fishes to expel the air from the bladder, or to take in air from the atmosphere by coming to the surface of the water.

The process to which the author subjects these fishes is as follows:—The fish is placed in a vessel of water under the bell of the air-pump; as the air becomes rarefied, bubbles escape from the mouth and opercular apertures. When, from the quantity of air expelled and the descent of the barometer which measures the pressure within the bell, it is supposed that nearly all the air is exhausted from the swimming-bladder, atmospheric air is admitted into the bell; and the fish, which previously floated freely, immediately falls to the bottom of the vessel, owing to the diminution in volume of the swimming-bladder. The fish is then transferred (care being taken that he does not get his head out of water) into a large vessel in which the water is constantly renewed. The fish then lies at the bottom of this vessel, creeping about rather than swimming; his efforts to rise to the surface are rendered abortive by a partition placed below it. In a few days, or, with some species, in a few hours, the fish begins to swim with more facility, indicating that the swimming-bladder has become filled with fresh air, which has not been derived from the atmosphere. The fish is then killed by the section of the spinal cord effected under water; the duct is tied and the swimming-bladder removed to the mercurial trough, in order that the air which it contains may be collected and examined. The analysis of this air shows an amount of oxygen far superior to that of the air expelled under the action of the air-pump, and also to that contained in the air dissolved in the water.

Eight Tench were taken under the same conditions; seven were killed, and the air of their swimming-bladders gave 8 per cent. of oxygen. The eighth was treated as above, and killed in a fortnight; the air of its swimming-bladder gave 60 per cent. of oxygen.

Of three Congers, taken under identical conditions, one killed at once gave 30 per cent. of oxygen. Another was subjected to the action of the air-pump until the column of mercury descended to 20 centimetres (= 8 inches), and then placed in a basin of sea-water; in two days it gave 62 per cent. of oxygen. The third was subjected to the air-pump at a pressure of 9 centimetres (= 3.6 inches) on two consecutive days, then placed in the basin of sea-water, and killed twenty-four hours afterwards; the air in its swimming-bladder gave 87 per cent. of oxygen.

These examples suffice to prove that, in Physostomous fishes placed where they cannot obtain air from the atmosphere, the swimming-bladder is soon refilled with new air remarkably rich in oxygen, and, further, that this is the case even in species which do not possess the vascular organs known as the *red bodies*.

In the case of fishes with a completely closed swimming-bladder, the author punctured the bladder by means of a fine trocar, and collected a portion of its air under water. The thickness of the tissues penetrated prevents the access of water to the air-bladder through the very narrow aperture made by the trocar, which closes as the instrument is withdrawn.

Four Perch, taken under the same circumstances, were punctured under water. Their air contained from 19 to 25 per cent. of oxygen. When killed, ten days afterwards, the amount of oxygen was from 40 to 65 per cent.

Two Gilt-heads (*Sparus auratus*) furnished, when punctured, an air containing 16 to 17 per cent. of oxygen. When killed, two days afterwards, they gave 58 and 59 per cent.

A Wrasse (*Labrus variegatus*) gave on the first puncture 19 per cent., and twenty-four hours afterwards 57 per cent. of oxygen. Another Wrasse gave 18 and 85 per cent.

As the swimming-bladder cannot be completely emptied by the above processes, and the remainder of the air, which is very rich in nitrogen, is mixed with that which is finally obtained from the fish, it would appear that, in some cases at least, pure oxygen must make its appearance in the swimming-bladder.

In a previous communication the author stated that asphyxia is the cause of diminution in the proportion of oxygen in the swimming-bladder, and also that this proportion diminishes by degrees, and only reaches zero in the last moments of the life of the fish. If the complete disappearance of the oxygen be desired, the fish must be asphyxiated, in a larger quantity of water in proportion as he is more vigorous and contains air rich in oxygen in his swimming-bladder. Those fishes in which the swimming-bladder possesses no red bodies, present a comparatively slight diminution of oxygen when asphyxiated. Carbonic acid exists in the air of the swimming-bladder; but in most species examined by the author it was rarely present in a larger proportion than 2 or 3 per cent. Asphyxiated fishes do not exhibit an increase of this gas proportional to the diminution of oxygen.

The author sums up his results as follows :—The air of the swimming-bladder presents a composition which may vary more or less, relatively to the proportion of oxygen, under the following circumstances :—

1. The oxygen diminishes and disappears in asphyxia and other morbid conditions.

2. In the fishes with an open, as in those with a closed swimming-bladder, the air is renewed without being derived from the atmosphere, and the rapidity of this renewal is proportional to the vigour of the fish.

3. The new air presents an amount of oxygen far superior to the proportion of that gas usually contained in the air of the swimming-bladder, and also far superior to that contained in the air dissolved in the water.—*Comptes Rendus*, Nov. 16, 1863, p. 816.

On the Intercellular Substance and the Milk-Vessels in the Root of the common Dandelion. By Dr. AUGUST VOGL.

The root of the common Dandelion possesses a central woody body, surrounded by a thick, fleshy, strongly milky rind. If fine sections of the root be treated under the microscope with various chemical reagents, it appears that the intercellular substance occurring in the root consists chiefly of pectose—the same substance which occurs in unripe fruits and in turnips and carrots. By this it is shown that this substance is by no means a secretion, but a product of conversion of the cellulose of the cell-membranes. This conversion is chemical in its nature, and proceeds from without inwards. The production of the milk-vessels in the root of the Dandelion stands in connexion with this pectinic metamorphosis. The milk-vessels which occur in this plant are perhaps among the most ramified which occur anywhere in plants. They form main stems, which, united into bundles, pass through the bark in a direction parallel to the axis of the root. These main stems throw out a quantity of lateral shoots—sometimes as short transverse branches of intercommunication, sometimes as caecal branches of greater or less length, which are either inflated into a knob or drawn out to a hair-like fineness at the extremity; the different bundles are connected in a tangential direction, and thus form large reticulated systems around the woody nucleus. On examining into their origin, it appears that their main stems are produced by the amalgamation of the so-called conducting cells (*Leitzellen*, *Siebzellen*) which accompany the bundles of milk-vessels, and probably constitute the organ for conducting back the juices elaborated in the leaves. This fusion is induced by the conversion into pectose of the membranes of the cells, consisting at first more or less entirely of cellulose.—*Bericht der kais. Akad. der Wissenschaften in Wien; Math.-naturw. Classe*, Dec. 17, 1863, p. 10.

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XXVII.—*Histological Researches on the Formation, Development, and Structure of the Vegetable Cell.* By Prof. H. KARSTEN*.

[Plates V., VI., VII.]

Historical Introduction.

SINCE the period when Malpighi, Grew, and Leeuwenhoek laid the foundations of vegetable anatomy, and Moldenhauer, Mirbel, Bernhardt, Treviranus, Rudolphi, Link, Meyen, Unger, Dumortier, Mohl, and others demonstrated the tissue of plants to be composed of distinct independent cells, the history of the development of the cell itself has formed an object of inquiry. As yet, however, the researches made on this question have led to no uniform and constant conclusions, as, indeed, from the very nature of the inquiry, might have been anticipated.

On the one hand, Mohl, in 1835, maintained the hypothesis of the multiplication of cells by fission of pre-existing cells, effected by means of septa commencing as folds from the sides of the cells and advancing until they met in the centre. On the other hand, Schleiden seized on the fact of the frequent presence of a nucleus, which Robert Brown had pointed out in cells where an active process of development was going forward, and employed it to construct a contrary doctrine of cell-production.

Schleiden regarded this nucleus as the basis and builder of the simple cell-wall that encloses it, by effecting a transformation of the mucilaginous substance around it into a gelatinous envelope, which subsequently becomes the membranous wall. Into the gelatinous vesicle so formed Schleiden supposed the external fluid to pass on one side, and to distend it, so that the mucous corpuscle is set free on one side, but adheres to the inner wall on the other—and that then a second layer is produced on

* Translated by Dr. Arlidge from a separate impression kindly communicated by the Author.

its free surface, whereby the nucleus becomes involved in a duplicature of the wall, or remains free, and is at length mostly dissolved and lost to view.

The majority of naturalists are now agreed that, in the vegetable kingdom, free cell-formation from a more or less completely organized nucleus of a mother cell takes place, but is of rarer occurrence than the production of cells by fission, according to the views of Mohl.

In opposition to this hypothesis of a twofold type of cell-formation, I sought, in 1843, in my dissertation '*De Cella vitali*,' to establish the fact that the development of organic forms is subject to one single law, to the recognition of which the observation of the phenomena of development both of vegetable and animal tissues had led me, and of the truth of which I remain convinced now, after twenty years' study of this question, alike important both for physiology and anatomy.

Since that *brochure* is little known, and has been in some measure misunderstood, I will reproduce here those conclusions which relate to the question under notice:—

1. The formation of every cell within a living organism is original: the cell is not divided into two new individuals by longitudinal or by transverse septa, or by proliferation.
2. The evolution of a cell does not depend upon an antecedent formation of a solid nucleus.
3. In the first phase of its existence the cell resembles a small vesicle, very like a mere point.
4. In the organism the "cell of vegetation" does not exist in a simple form; for everywhere a secondary cell is present. Every elementary part of the organism (the cell is deemed elementary) consists of a system of endogenous cells; a member which is sometimes interpolated in this system of cells is the "cell of secretion."
5. In the secondary cell.....a nucleus is found, which Schleiden called the formative cytoblast of the cell, but which I regard as a small tertiary cell retarded in its evolution.
6. In the interior of a cell one or several cells are developed with greater or less rapidity, evidently in the same manner.
7. An organism potentially consists of one such system of cells, *i. e.* a cell of reproduction; actually of aggregated series, every one of which may be a cell of reproduction; never of a simple cell*.

- * 1. *Omnis cellæ formatio originaria est, intra vividum organismum; cella dissepimentis longitudinalibus et transversalibus aut proliferatione in duo nova individua non disjungitur.*
- 2. *Cellæ evolutio non pendet ab antecedente solidi nuclei formatione.*
- 3. *In primo vitæ suæ gradu cella parva, puncto simillima vesicula apparet.*
- 4. *In organismo non exstat cella vegetationis simplex; ubique enim secundaria cella adest. Quævis organismi pars elementaria (cella q. d. elementaria) ex endogenarum cellarum serie constat; mem-*

By this work I hoped not only to convince histologists of the compound structure of the elementary organs of vegetable tissue, the youngest member of which is the nuclear corpuscle, but also to prove to physiologists the intimate affinity of all the different endogenous members of one and the same system of cells, as well as the mutual action which takes place between the constituent walls of the endogenous cells and their fluid and solid contents—a mutual action from which not only the most material changes of form of the original structureless cell-wall proceed, but also the multiform and peculiar chemical combinations of its organic material.

The existence of a secondary cell in the tissue-cells of the large class of Algæ was proved by Kützing in the same year with the appearance of my essay, probably without his having any knowledge of the latter; and in the following year Mohl announced this structure, as ascertained by me, to be common to all plant-cells.

One portion of my work therefore promised to be serviceable immediately after its appearance,—the composite structure of the elementary organs of plants being recognized by the most experienced of histologists. But with respect to the functions of the different elements of this microcosm, and their purpose, I had not the good fortune to obtain Mohl's acquiescence; for whilst I sought to establish a successive endogenous formation of cells within one another, and was convinced of the continuation of an assimilative process in their often thickened and stratified walls, that illustrious observer adopted an opposite theory, and assumed that the thin, still nitrogenous delicate membrane which, at a certain stage in the development of most tissue-cells of plants, forms a lining to an outer and ligneous cell—the same membrane which I regarded as an endogenous secondary cell, growing eventually ligneous itself—is the first in origin (in Schleiden's sense) around the nucleus, the primary membrane of the whole system of layers found in the fully developed tissue-cell. He moreover implied that this cell-membrane, which he called the "primordial layer," remains un-

brum, quod interdum huic cellarum seriei interjicitur, est *secretionis cella*.

5. In secundaria cella....nucleus invenitur....quem Schleiden cellam formantem cytoblastum....vocavit, equidem vero parvam cellam tertiarium habeam, ab explicatione impeditam.
6. In interiore cellæ parte citius tardiusve vel una vel plures novæ cellæ plane eodem modo nascuntur.
7. Organismus potentia ex uno tali cellarum systemate, i. e. *reproductionis cella*,....actu e cellarum seriebus aggregatis (quarum unaquæque ipsa reproductionis cella esse potest), nunquam ex simplici cella constat.

changed until the cellulose membranes are deposited upon its outer and inner surfaces.

Again, Mohl, Schleiden, and their followers supposed that in this way a long-unaltered envelope is formed around the contents, which are kept in constant change by continual diffusion; whilst to me the phenomena of development appeared to indicate a simultaneous and continuous chemical alteration both of the membrane and contents of the cell.

Having illustrated in that essay the manifold phases of development of the membrane of the secondary cells, and fully described elsewhere (*Abhandl. der Berl. Akad.* 1847, p. 111; *Botan. Zeitung*, 1857, p. 314; *Poggendorff's Annalen*, 1860, No. 4) the various chemical metamorphoses of the outer and primary cell-membrane, consisting, at a certain stage of development, of cellulose—changes which have been more fully established by Wigand (*Desorganisation der Pflanzenzelle*, 1862)—I shall here endeavour again to prove that all cells of vegetable tissue, as far as observation has yet gone, originate as minute free vesicles within the fluid contents of previously existing cells, and attain their normal dimensions after undergoing many determinate chemical changes; and, moreover, that the involution of the parent cell to form septa, as far as is yet made out, though it may accompany its multiplication, does not originate or cause it.

Besides the tissue-cells which originate in the juices of the cell, either singly for the maintenance of the individual, or several together for the purpose of multiplication, there appear in the cell-fluid generations of cells, originating and disappearing in manifold sequence, which are recognized as the producers of the more composite organic compounds, and partly also as the cause of the variety in the form of the thickening layers of the originally structureless membrane of the tissue-cells to which they adhere.

That these non-nucleated vesicles (starch, chlorophyll, &c.), spoken of by me as secretion-cells, are actual cell structures, and not structureless corpuscles, is not merely a curious histological fact, as it was in a great measure regarded by the older anatomists, but one of great importance to the physiologist; for if an anatomist of note, speaking of the constant tendency of anatomy towards the investigation of the most minute conditions of organization, has asserted that physiology will subside into a subtle anatomy, experience will soon show, on the contrary, that physiology will rather rise in a subtle anatomy.

In the following pages the nature of the origin and of the growth of all the cells of the different tissues of the organism cannot, necessarily, be demonstrated; for with many of them

this would be scarcely possible, by reason of the peculiar conditions of their development: with others I have performed this task; and respecting the origin of the rest, I have assumed it to be analogous.

Doubt has been thrown partly upon my observations, and partly upon the conclusions drawn from them. In order to complete the former by a detailed statement of the phenomena which most appeared to stand in opposition to my view, I will here especially demonstrate the free endogenous origin and growth of cork- and pollen-cells, and of the tissue-cells of the simple *Algæ*, which have chiefly been cited as evidence of cell-formation by constriction; and I shall then consider myself justified in assuming that the same law applies also to the origin and growth of other cells.

By the fuller elaboration and the solution of these questions, the conviction will be arrived at that the vesicular structure (which takes on at once the character of an active cell, and the properties of which are dependent on the peculiar relative composition of its formative materials) progresses in a course of development determined by continuous changes in the physical and chemical condition of its membrane and cell-contents, therein resembling the organism at large, in the effectual working of which it has its own part assigned to it.

By this means physiology will acquire the necessary basis for the right understanding both of the vegetative and animal functions of the organism, which it is now attempted to explain, in an equally one-sided and defective fashion, as the action of a few or individual physico-chemical forces governing the evolution of the cell.

§ I. *Development of Cork-cells.*

In *Cecropia*.—In *Philodendron*; in the cells of which they also develop manifold.—Porous, thickened cork-cells.—Restoration of their original spherical form by ammonia.—Absorption of their mother cells.—Growth of a cork-cell out of a cell into the neighbouring vessel.—Cork-cells in crystal-cells.—Cork-cells not developed in lacteal vessels and branched fibrous cells of the bark.—Cork-cells and callus-cells anatomically equivalent.

The origin of cork-cells within those of the epidermis and bark has hitherto been ascribed by the few anatomists who have expressed a definite opinion upon this subject to the sudden appearance of a partition dividing the mother cell into two parts. This opinion has arisen from the circumstance that the investigations upon which it is based were made upon the cork-formation of the bark, which does not present a favourable example, as in it the actual moment of the formation of new cells in the bark may easily be missed.

The statement given by me as to the mode of production of cork; in my investigation of *Cecropia peltata*, Linn. (Acta d. Akad. d. Naturf. xxiv. pt. 1. p. 86) has not been taken into consideration by my successors. In this plant, in the outermost lamina of a collenchymatic tissue covered by the epidermis, and at the commencement of the second period of vegetation, I observed the formation of some small cells, filled with colourless fluid, in contiguity with the chlorophyll-vesicles. These colourless cells develop themselves, in the peripheral cells of the lamina in question, into cork-cells simultaneously with the absorption of the chlorophyll, and in those on the central aspect into parenchyma-cells of the bark, in which cork-cells are subsequently formed in the same manner.

Less difficulty is experienced in the observation of the formation of cork-cells when this tissue is developed in the process of cicatrization after an injury to a stem, by which the normal functions have been suddenly arrested—a circumstance partially studied by Mohl in his memoir on the process of cicatrization in plants (Botanische Zeitung, 1849, sp. 641). Hitherto I have been most successful in following up the history of the development of cork-cells in all its stages in the commonly cultivated *Philodendron pertusum*, Kth.

If a stem of this plant be cut through at the middle of the internodes, and the lower extremity of the piece cut off be stuck in moist earth, as soon as the adventitious roots already formed in the bark begin to be developed, very similar but not quite identical alterations take place in the tissues contiguous to the two cut surfaces. The organic constituents dissolved in the evaporating nutritive fluid collect beneath the dried layer of cells which soon covers the fresh-cut surface on exposure to the atmosphere, and are partly assimilated by the cells of which the various tissues of the mature stem of *Philodendron* are composed, and partly coagulated and chemically altered in many ways within the cell-membrane by the air which penetrates into the wounded tissues.

On the end dried in the air the stratum of cells saturated with nutritive fluid, but completely desiccated, is considerably thicker than on the lower extremity, where it consists of one or a few layers of cells; the vascular bundles also dry to a greater extent inwards than even the cellular tissue, so that a dead portion of these afterwards projects into the living tissue, and appears as if the latter had grown over it.

Within the cells, rich in plasma, which lie next the withered layer, nuclear cells, containing nuclear corpuscles, make their appearance. These, however, do not acquire the size of the parent cells, but become displaced by two cells originating and

growing with them in the juice of the cell, and either nucleated or non-nucleated according to the chemical constitution of the plasma, or are enclosed between these during their growth, and absorbed; at any rate, they disappear.

The two newly formed and very thin-walled cells subdivide within the cavity of the mother cell, and so completely occupy it, and are so intimately moulded to its walls, its pores, rings, and spiral windings that they can scarcely be distinguished from its membranes. In the same way, the septum, which owes its origin to the apposition of the two daughter cells within the parent cell, is of such great tenuity as to appear like a single lamella.

The same new formation proceeds in the cells of the cortical tissue next the epidermic layer; and in this region the newly formed tissue extends from the cut surface almost as deeply within the cell-tissue as the dead portion of the vascular bundles. These newly formed pairs of cells are always arranged, in the upper section exposed to the air, in a direction perpendicular to the adjoining dry and air-containing cell-tissue, and more or less indeed in the same peculiar manner as the cork-cells of the bark, forming uninterrupted rows with the successively produced young cells. These are united in the parenchyma in a plane parallel with the cut surface, and which, close to the epidermis and round the vascular bundles, is turned inwards. By this means the surfaces of the dead extremities of the vascular bundles projecting into the living parenchyma are invested by a sheath formed by a stratum of cell-series standing perpendicularly to their longitudinal axis.

This production of cork-cells is moreover found not only in the cells of the parenchyma, but also in the cells and vessels of the vascular bundles; so that even the latter become occupied by a layer of cork-cells, and the undisturbed tissue of the internode is separated by this intimately adherent layer of cork-cells from the withered tissue, and also protected from the immediate influence of the atmospheric air.

The cork-cells do not always arise in pairs, but in larger number sometimes in cells of greater length. In the elongated cells of bast and wood, as well as in the vessels, there are usually numerous cells, arranged in rows, beginning at the end towards the cut surface, filling up the long cells more or less completely. In the vessels, moreover, they still oftener give origin to an irregular tissue.

The enlargement of the cells filled with transparent fluid, produced together with the cell-nucleus, must take place with extraordinary rapidity in the vicinity of the cut surface, in the manner that may be directly observed in the tissue-cells of a

species of *Edogonium* which will hereafter be described. This may explain why Mohl and Sanio did not observe it, and why I only succeeded a few times in meeting with stages of development corresponding with that shown in Pl. V. fig. 8.

The presence of a lamina of cork of some thickness retards, on the one hand, the flow of nutritive juices and their concentration by evaporation, and, on the other, restricts the action of the atmosphere on the cells assimilating it; the newly generated cells then extend themselves more slowly, and even appear to remain in a half-evolved condition; at least, in the line of demarcation between the cork and the unchanged cells of the tissue, some of the latter are occasionally noticed to contain delicately walled cells and vesicles, which possess the chemical constitution of cork, and present all the intermediate stages to that of the completely developed periderm, as is shown in Pl. V. fig. 2 *x*, in the case of a thickened porous cell of the medullary sheath, and, in fig. 5, in that of a vessel.

The most recently developed peridermic cells behave like cellulose with a solution of iodine and chloride of zinc, but soon lose the property of becoming blue on the addition of iodine and corrosive reagents, which property they indeed do not possess in the first period of development. Probably cell-nuclei occur in all cork-cells during a certain stage of development; and their duration seems to depend on the quality of the nutritive fluid absorbed by the cell-tissue, and on the chemical composition of the plasma within the cells, as well as on the more or less immediate access of atmospheric air.

The first-formed cork-cells contiguous to the withered cell-layer mostly remain simple, whilst those subsequently produced contain a further generation of two or more new cells. In this manner such a cork-cell becomes occupied by a complete cell-tissue, the very delicate walls of which are in such close apposition that they leave no intercellular spaces between them, and cannot be recognized as consisting of a double membrane.

Some layers of these cork-cells in the immediate vicinity of the cut surface, soon after their evolution, acquire stratified thickenings of their secondary cells, which are penetrated by a few pore-canals.

On resolving the tissue containing the cork-cells into its separate cells, by boiling it with nitric acid and chlorate of potash, and on subjecting it to the action of ammonia, the cellulose walls of the parenchyma become more or less greatly swollen, or are entirely dissolved. In the latter case, the solution of ammonia also acts upon the coherent groups of cork-cells derived from the dissolved cells, and causes them to swell up, to assume a spherical form, and to part asunder (figs. 14 & 15). In this

way the true nature of the apparently simple lamellæ which form the septa is placed beyond doubt.

The cork-cells which are found in the much-thickened fibrous cells of the bark, furnished with deep porous canals (Pl. V. figs. 1 & 19), exhibit with particular clearness the true impression of the cell-cavity which enclosed them (fig. 20). The same fact is also displayed in the cork-cells of the very thickened parenchyma-cells and spiral vessels (figs. 2, 3, & 4).

During the process of development of these endogenous cork-cells, the substance of the walls of the parent tissue-cells becomes entirely absorbed. And by means of this process of absorption the various component tissues of the stalk are eventually replaced by a completely homogeneous layer of cork, in which the outline of the original histological elements cannot be recognized, as Mohl has shown in his researches on the normal cicatrization of the stalk after the fall of the leaves and that of the points of its terminal shoots.

The dissolution of the walls of the tissue-cells filled with cork-cells commences with the external membrane of the primary cells, and terminates with the inmost layer of the secondary cells; so that the pores of the very thick porous cells of the medullary sheath acquire large dimensions shortly before their final disappearance.

In the case of spiral vessels filled with cork-cells, the spiral fibre is not unfrequently left; it then coils round the serially appressed cork-cells, and may be untwisted from them (fig. 3). This condition affords still more certain proof of the presence of these endogenous cells within spiral vessels, and also of the fact of their being free isolated cells which more or less completely fill the cavity.

Sometimes, however, specimens are met with which prove that the filling of a spiral vessel with cells has proceeded from the neighbouring tissue-cells, the endogenous cells produced in and entirely filling which have extended from them into the adjoining spiral vessel (fig. 4). Hence the supposition might be entertained that the incompletely developed cork-cells found in porous vessels and cells (figs. 2 & 5) have likewise not freely originated in them, but have grown into them from neighbouring cells. Nevertheless, by causing the vessels set free by boiling with nitric acid and chlorate of potash to rotate on their axes, we may positively ascertain that their contents are really perfectly isolated free cells.

The cases in which the intrusion of a cork-cell into a spiral vessel from an adjoining tissue-cell is observed are uncommon; and such are, without doubt, due to a coalescence of the woody cell with the vessel before the development of the periderm, as

I have repeatedly observed, for example, in the wood of *Cinchona*.

Among the large cells of the vertically elongated parenchyma of the stem of *Philodendron*, some scattered rounded cells are met with almost completely filled with a large crystalline mass of oxalate of lime. In these cells also, when occurring in a mass of cork-tissue, some young cells are seen to originate between the crystalline mass and the parent cell, which, after having acquired their full dimensions, have a cellulose composition, and ultimately become converted into cork. These cells so entirely surround the crystalline mass that it appears to be enclosed within an envelope of small irregularly shaped cork-cells intervening between it and the parent cell-wall (fig. 2 k).

Besides these kinds of cells, which all contribute to the cicatrization of the cut surface by the formation of cork, two other elementary organs are encountered in the tissue of *Philodendron*; in these no cell-development takes place, but they become absorbed within the layer of cork-cells. The first of such organs are the series of cells, united with fibres and filled with raphides, which are found dispersed in the parenchyma of the bark and of the medulla, and which in other Aroidæ contain a milky juice. The second kind are the branching fibrous cells found only in the cortical tissue. Both these structures are, in all probability, principally concerned in the process of secretion—an opinion which I expressed suppositively, in my 'Dissertation,' with regard to the thickened secondary membrane; I also specially mentioned the absorption of the fibrous cells of the bark, in my Memoirs on the Palms and on the China-barks (Die Vegetationsorgane der Palmen, 1847, p. 53, and Die med. Chinارينden Neu-Granada's, 1858).

These fibrous cortical cells of the *Philodendron* have a remarkably ramified form, giving off from each side of the upper and lower extremities of the parallelopipedal and horizontally extended cells two very long and thin branches, which lie free in the comparatively wide intercellular spaces, and end in pointed closed extremities. These long branches, standing out at right angles from the cell, are not produced until after this has attained its full size; and soon after the outgrowth of these processes the entire cell-wall proceeds to increase in thickness. It can indeed be distinctly made out that these cortical cells, as well as the lacteal vessels, here occupied by raphides, originate from cells, and not from intercellular spaces lined with cell-material.

In my paper on tannic acid (Monatsbericht der Berl. Akad. der Wissenschaften, 1857) I described the lacteal vessels of *Colocasia*, *Dieffenbachia*, and other Aroidæ through which a

fluid containing tannic acid is diffused. These lacteal vessels resemble the ramified fibrous cells of the bark, in sending off branches into the intercellular spaces, the membranes of which, from their extreme tenuity, may be readily overlooked, and thus give rise to the inference that the lacteal fluid circulates within the intercellular spaces themselves. I believe I have proved in that memoir that the lacteal vessels do actually possess walls of their own; they are therefore, with reference to their mode of origin, analogous organs to the fibrous cells of the bark.

The processes which go on in the formation of the so-called *callus* on the lower part inserted into moist earth are precisely similar to this formation of periderm; and this was particularly the case in cuttings of *Philodendron* when these were terminal shoots, and had continued to develop themselves after their separation from the lower part of the stem.

Under these circumstances also, a layer of cork is first produced on the cut surface (which, owing to its being implanted in the moist earth, scarcely undergoes any desiccation), to protect the living tissues from the access of air. However, the cork-lamina does not acquire the same proportion as in the process of cicatrization in the air, nor does it penetrate so deeply within the plant-tissue near the epidermis and vascular bundles; and after the peridermic layer has attained a certain thickness, the cells formed deeper within the tissue are not cork-cells, but, like the cambium-cells of the apex of the axis, become converted into the most various histological elements.

Two cell-nuclei are frequently met with in one mother cell, each containing either two nucleolar corpuscles or two vesicles of a larger size and having each two nuclear cells, whilst no cell-nucleus belonging to the cell-system of the mother cell is contemporaneous with them.

Crüger, who first fully described (*Botanische Zeitung*, 1860, p. 369) the changes in the cell-tissue during the formation of *callus*, supposed that no new formation takes place in the cut vessels. This, however, is an error ascribable without doubt to the great tenuity of the walls of the endogenous cells, the appearance of which is a counterpart of what has been already described and figured (Pl. V. figs. 3-5), except that these cells are still more hyaline and transparent, inasmuch as they are defended from the contact of the air, and consequently not rendered suberous (*verkorkt*).

I have found the vessels contiguous to the *callus* filled with new cells, not only in endogenous but also in exogenous plants—for example, besides *Philodendron*, in *Zingiber*, *Dracæna*, *Zamia*, *Cycas*, *Ficus*, *Gesneria*, &c. In all cases the fully developed vessels have a much greater tendency to generate new cells in

their interior than the ligneous cells themselves, and this even without any wounding of the vessels. I removed a ring of bark from a twig of *Salix babylonica*, and found, in the following year, all the vessels of the peripheral lamina of the wood entirely filled with cells, whilst the woody cells, on the contrary, remained unaltered. The cells thus formed in the interior of vessels may, under certain circumstances, be transformed into new vascular cells, after the thickened wall of the parent vessel has been absorbed, and may contribute to the lengthening of the original vessel—a case which I have described and figured, in my researches on the organs of vegetation of the Palms, with regard to *Lycopodium Springii* (pp. 120 & 163, pl. 9. fig. 15), the vascular bundle alone having been developed into a root-fibre.

By the maceration in solution of potash of the cells which make their appearance in the vessels during the formation of callus, it may also be demonstrated that they are not produced by constriction, but as free vesicles in the fluid contents of the cells and vessels, although the observation of the moment of their production presents exactly the same difficulties here as in the case of the suberous tissue.

§ II. On Cell-formation in *Edogonium*.

New joint-cells by evolution of endogenous cells.—Absorption of the secretions of the mother cell, with contemporary formation in the daughter cells.—Absorption of the nuclear cell.—Development and growth of the nuclear cell.—Cellular contents of the developed joint-cells.—Downward-prolonged annular folds of the primary cell-wall.—Bary's globules of decomposition contain animal parasites.

The peculiar behaviour of the mother cell, in the several species of the genus *Edogonium*, during the formation of daughter cells, has been most fully elucidated by Bary (Schriften der Senkenberg'schen Gesellschaft, Band i. 1854–55). From his investigations we know that, in the course of elongation of a joint-cell, the primary cell-wall forms at its upper part an ingrowing annular fold, and that this fold, after the membranous envelope covering the mother cells is torn through, suddenly extrudes itself, and thus causes a considerable elongation of the joint-cell.

The internal structure of the *Edogonium*-cells and the mode of multiplication of the joint-cells have, however, not yet been ascertained. The latter is, as usual, represented to be a consequence of the formation of septa by constriction of the walls; and, according to Bary, the septum is formed in the suddenly extended cell within a colourless layer which divides the green mass of contents into two parts, and not until this layer has issued from

the lower sheath-like portion of the circularly torn membranous wall, in consequence of the gradual expansion of the inferior mass of the cell-contents. Bary regards the lower of the two new and simultaneously produced cells as the parent of the upper.

The real process of cell-multiplication does not agree with this description. The transverse cell-wall does not originate only outside the enveloping membranous sheath, in accordance with the prevailing opinion, by the inward growth, from the surrounding wall of the elongated mother cell, of a fold-like or lamelliform horizontal septum ultimately meeting at the centre, but, on the contrary, it is present and complete before the rupture of the membranous wall and the occurrence of the abrupt elongation of the mother cell.

The thickening, and not the formation of the transverse septum, follows after the changes described by Bary have taken place in the mother cell when this escapes from the membranous enveloping sheath, which until then encloses that portion of the joint-cell in which the transverse septum arises, by the development of daughter cells, in precisely the same way as the formation of cork-cells in *Philodendron pertusum* has already been described.

The existence of the transverse septum in the joint-cells which are not yet elongated, and indeed in those in the upper end of which the fold of the mother cell is already produced, is particularly easy of demonstration in the species of the genus *Cedogonium*, as Hartig and others have indeed actually witnessed; but it is not so with respect to the mode of origin of the septum. The great quantity of chlorophyll- and starch-corpuscles which cover the inner surface of the cell-walls of these plants, when in vigorous growth, renders it impossible to make out with any certainty the development of new cells within these joint-cells.

In my researches I employed plants of *Cedogonium grande* which had been raised from spores in pure water, and many of whose cells were scantily occupied by chlorophyll, so that the changes which took place in the other contents could be more clearly examined.

In such plants it is possible to make out the true mode of formation of the septum, which is thus effected:—two of the many non-nucleated hyaline cells which occupy the interior of the joint-cell acquire a greater size (Pl. V. figs. 21, 26, & 28), and by their growth press the others to one side against the wall of the mother cell (which is coated with chlorophyll, starch, &c.), and eventually come into contact and by their mutual apposition form the septum, often obliquely placed at first, and completely fill up the cavity of the mother cell (figs. 27 & 29).

This process occupies some few minutes; and in order to observe it the eye must be fixed upon some one such cell containing but little chlorophyll, and in which the fold of the wall is fully formed, though a septum be as yet not present in it.

After the septum has attained the characters of a complete disk dividing the cell-cavity, an act of growth, or at least an expansion of the cell-wall, still goes on, whereby the rather obliquely placed septum acquires a horizontal direction, and a certain amount of pressure is at the same time exerted upon the cell-wall, which forces apart or extends the fold (above which the enveloping membrane is torn through), and thus enlarges by about one-third of its length the mother cell of the two newly developed cells (figs. 22 & 23).

Contemporaneously with this sudden evolution of the mother cell, the two endogenous cells undergo expansion. When both these cells are not equally enlarged, it is, as a rule, the upper one (usually the smaller of the two) which at first expands comparatively more strongly, and at the same time downwards towards the new septum, whilst the chlorophyll- and starch-vesicles, compressed against the walls of the mother cell, do not at first undergo very much displacement. This is the reason why, at the first moment after the extension of the mother cell, the new septum is usually found free from secretory vesicles, and only bounded by a transparent watery fluid (Bary's colourless layer), as happens also with the inferior extremity of the lower of the two daughter cells.

This primary and abruptly accomplished enlargement of the endogenous cells, after the laceration of the enveloping membrane, is, like that of the mother cell itself, only a mechanical act,—not a process of growth, but merely the extension of the cell-wall already enlarged by assimilation. The secretion-corpuscles, however, gradually distribute themselves equally over the whole surface—except that, quite at the upper end, at the summit of the mother cell, a compact group of these secretion-corpuscles remains, even in cells otherwise almost destitute of such contents, whilst the lower extremities of the two young daughter cells usually continue longest free from these substances, and appear colourless.

Nevertheless, this distribution of the secretion-material is not so rigorously subjected to the rule just mentioned as not to admit of exceptions.

These relations are, however, it appears to me, worthy of notice, because they may furnish data for arriving at conclusions respecting the place of formation of the secretory material, the direction of the cell-growth, and therefore the direction or course of the nutritive matters distributed in the series of cells.

It would appear that those materials which are subservient to the growth of the young cell-wall pass from the lower to the upper portions of the plant, whilst chlorophyll is produced from compounds which diffuse themselves from the upper into the lower parts of the plant.

During the first period, which ensues upon the unfolding of the annular fold and the extension of the cells, the upper young joint-cell usually remains more or less unchanged; the lower one, on the contrary, continues to enlarge, whereby the new and still delicate transverse septum becomes pressed upwards, until it at length projects from the opening in the lacerated membranous sheath, and then it proceeds to increase in thickness. (Pl. V. figs. 23, 24.)

Bary asserts that he distinctly made out that the septum is produced by a gradual constriction and secretion of the primordial layer, in various species of *Cedogonium*, after the protrusion of the clear lamina from the membranous sheath. In the treatise quoted (at p. 42) he says:—"In any case, the septum is not simultaneously formed in its entire surface; on the addition of a solution of chloride of zinc and iodine, the contracted primordial layer is sometimes distinctly seen to pass through the middle of an incompletely closed dissepiment."

That this phenomenon, which I have figured in a *Spirogyra* (Pl. VII. fig. 67), and to which I shall hereafter revert in connexion with *Cladophora*, furnishes no sufficient proof of the production of the dissepiment by constriction, will be shown when I come to speak of the latter genus.

Of the formation of a fold in the membrane of the mother cell, after the two daughter cells (figs. 21, 26, 28) have become mutually pressed together so as to form a complete septum (figs. 22, 27, 29), and of an eventual inward extension of this fold betwixt the lamellæ of the septum, which are thus again separated, I have no knowledge; but the more distinct appearance of the long-previously existing septum can, in my opinion, be much more readily accounted for by the gradual thickening that progresses in it from its circumference. That this thickening of the septum always follows after its emergence from the enveloping sheath is in all probability to be attributed to the changes in the nature and operation of the nutritive matters derived from without, now only through the walls of one assimilating and secreting system of cells.

In the mean while, the upper of the twin cells also begins to grow vigorously, until at last it equals the lower one in length. Nevertheless it not unfrequently remains somewhat shorter, which is the cause of the irregularity seen in the structure of *Cedogonium*.

Nägeli urges, in opposition to the notion of the formation of free cells in the fluid contents of a cell laden with various solid matters, that changes must have been observable in the solid contents adhering to the wall of the mother cells, should these become dissolved in the mother cell and afterwards organized anew in the daughter cells.

Well founded as is this supposition of Nägeli's as to the metamorphosis, the notion that such a metamorphosis does not take place is equally unfounded. Indeed, in my essay 'De Cella vitali' (1843, p. 71), and elsewhere, I have maintained the occurrence of those conditions subsequently called in question by Nägeli, asserting, as a result of my observations, that the secretion-material contained within the mother cell serves as nutritive matter for the ensuing generation. A conviction of the entire correctness of this statement, and of its high importance for the right understanding of cell-life, may be most readily attained by the examination of the species of *Œdogonium*, which, on account of their remarkable tenacity of life (in which they almost equal *Conferva glomerata*), are particularly well adapted for being observed continuously under the microscope during the successive stages of their process of growth.

Indeed the entire cell-contents of the joint-cell, which has been recently divided in the manner described into two portions, are now found interposed between the outer surface of the two daughter cells and the inner aspect of the wall of the mother cell. The large, thin-walled, non-nucleated cells (vesicles), filled with transparent fluid, existing at the time of the growth of the daughter cells, are at this period no longer present; indeed they disappear during the first stage of development of the young daughter cells, to which they probably serve as nutritive matter. On the contrary, the chlorophyll and the usually large starch-granules met with in the different species of *Œdogonium*, in variable quantity according to external vital conditions, are rather rapidly dissolved during the growth and the thickening of the membranous walls of the young joint-cells, in order to supply nutritive material for the process of assimilation of the cell-walls as well as for the new generation of cells and of secretion-vesicles in process of formation within the two daughter cells. This dissolution of the starch-corpuscles is completed in about twenty-four hours.

The chlorophyll first undergoes this process of absorption, and afterwards the large amylaceous corpuscles; and then they progressively reappear, but in the opposite order, in the interior of the newly formed joint-cells. In the first instance, small starch-corpuscles make their appearance, then the chlorophyll-vesicles, and, lastly, those large hyaline vesicles which, in the

normally developed and well-nourished cell, are for the most part not perceptible externally, and which originate by the growth of small yellowish-coloured vesicles, very similar to those of chlorophyll in their earliest stage. In many cases also it may be distinctly seen that a starch-corpuscle occupies the position of a nucleus within mature chlorophyll-vesicles.

Bary's idea that chlorophyll occurs in the external layer, and starch more in the interior of the joint-cell, will not, therefore, hold good. Indeed, in my researches on *Vaucheria* (Botan. Zeitung, 1852), I showed that in that plant the starch was usually to be found towards the exterior of the cells that contained chlorophyll. The same obtains in *Edogonium*, in those cells in which new joint-cells have originated. The large, much-thickened starch-corpuscles, when chlorophyll is not present with them, are met with external to the cells which contain chlorophyll as well as delicately walled starch-vesicles. The explanation of this relation is to be found in the successive development of new endogenous cells within the joint-cell of the *Edogonium*.

As the phases of development of neighbouring joint-cells of *Edogonium* differ very much from each other, so also do the joint-cells often present very different conditions in regard to the distribution of the secretory materials contained within them.

The true nature of the functions of the nuclear cell (nucleus) in relation to cell-formation in general, as well as to the multiplication of cells, in the case of *Edogonium*, has not been rightly understood. A cell-nucleus is frequently absent from the cells of *Edogonium* during the formation of new cells—probably, indeed, more frequently absent than present; and without doubt its existence, or rather its form, is dependent on the conditions of nutrition and on the chemical composition of the plasma. Besides, where the nucleus is present, it can be shown that the origin of new cells, and still more the formation of a septum, is quite independent of it.

In those cells wherein a nucleus of the ordinary form exists at the time of the formation of new cells, it is found to lie often on the wall of the mother cell (fig. 28), often in the median line, sometimes at its centre, and at others nearer to one end; and, in the course of the growth of the daughter cells, which do not originate in contiguity with it, it becomes thrust to one side along with the other contents, and pressed against the inner wall of the mother cell. In this position it immediately begins to undergo absorption—a process which seems to be frequently preceded by a swelling-up of the nucleus. Mostly this act of absorption is speedily completed; and then only does a nucleus make its appearance in each of the two new joint-cells, hitherto

destitute of any solid contents, and prior to the origin of any of the other varieties of secretion-vesicles (fig. 29).

In "resting" vegetative cells, i. e. in those which for a long time continue apparently unchanged, and which present no new formation of cells for the purpose of multiplication (neither vegetation- nor reproductive cells), there nevertheless occurs a continuous, though a very tardy, regeneration of the cells themselves.

Whilst the external primary cell-membranes are being dissolved, and replaced by the thickening membranes of the secondary cells, nuclear cells, long persistent in an embryonic condition, increase in size and assume the functions of secondary cells. The secretory materials contained in these (consequently exterior to the nuclear cell) are dissolved during this development of the nucleus, and within the nuclear cell, which has reached the dimensions of the mother cell, other similar secretory vesicles become developed.

In consequence of this development of the nuclear cells, secretion-vesicles are found not only on the outside of the two daughter cells, but also of the secondary cells, of the *Cedogonium* joint-cells at certain stages of development. These secretion-cells are usually starch-globules; for the chlorophyll was the first displaced and lost. (Pl. VII. fig. 63, as seen after the action of a weak solution of glycerine.)

In many cells a weak aqueous solution of iodine shows the presence of starch in solution betwixt the inner membranes of the cell. Mohl mentions this circumstance, and describes this, together with other allied structures, as a mucilaginous deposit around the primordial layer coloured blue by iodine (*Botanische Zeitung*, 1855, p. 732).

Before the application of the iodine, this layer has the appearance of a turbid solution of gum or mucus, but afterwards forms a clear transparent fluid: it therefore behaves like finely divided starch.

The two newly formed joint-cells, after the production of the septum by their apposition, cannot again be separated by the agency of endosmotic media, nor do they become detached thereby from the enclosing secondary cells of the mother cell.

If such cells are allowed to remain in saline or acid solutions, or in glycerine, &c., the membrane of the secondary cells enclosing the new cells and other contents loosens itself from the primary cell of the joint that is undergoing fission, and collects into a mass along with the whole of the contents in the interior of the cell: in this condition it shows no cellulose reaction.

It is not until after the further advance of the absorption of the secretory matters which occur outside the young joint-cells,

after the thickening of their walls and of those of their mother cell has commenced, coincidently with the more distinct protrusion of the dissepiment, that the application of solution of chloride of zinc and iodine produces a blue coloration of the external membranes of the new joint-cells and of their now likewise thickened and closely embracing mother cell; and this happens contemporaneously with the detachment of a secondary cell, which up to this period could not be isolated.

The difficulty, or perhaps, at present, more correctly speaking, the impossibility, of effecting, by the agency of endosmosis, the separation of the closely approximated membranes of the two endogenous cells from their mother cell (the secondary membrane of the joint-cell), or, before the thickening of their walls, from the secondary cells within them, is owing in part to the nature of the intercellular substance, and in part to their very similar chemical and physical (diosmotic) properties.

The similarity or identity of these membranes is so great, indeed, that it is extremely difficult to determine whether the young cells consist of a single or double cell-wall, and whether the enveloping secondary membrane of the mother cell is still present or has been destroyed. It is moreover somewhat difficult to make out with certainty the presence of the large vesicles filled with colourless fluid amid the corpuscles of chlorophyll and starch within the cavity of the cell.

In many species of the genus *Spirogyra*, and still more easily in *Cladophora glomerata*, we may ascertain, by cutting through their joint-cells under water, or by the action of different reagents, that these cells are filled with a delicately walled cellular tissue. And we may sometimes be so fortunate as to witness the complete extrusion of the new joint-cells (themselves also occupied by cellular contents) from the mother cell before their membranes are thickened.

In *Edogonium*, the joint-cells of which acquire cellular contents only after they have attained their full size, and simultaneously with the commencement of the thickening of their walls, these are no longer protruded from their mother cell; and in their younger phases (in which, as they then only exhibit fluid contents, they cannot be distinguished from the large neighbouring secretion-cells) they are furnished with walls as delicate as those of the latter, and are immediately dissolved by contact with water. Indeed it is only when sections of such plants are made in a weak solution of gum-arabic, instead of water, that we can succeed in observing for any length of time the very delicately walled, easily overlooked, endogenous, non-nucleated cells emerging from their parent cell; and even then it is impossible, for reasons already stated, to distinguish whether these are only trans-

itory secretion-cells or the early stages of development of new joint-cells.

It has been satisfactorily shown by former observers, and especially by Bary, that the thickened membranes of *Edogonium*, and particularly the extensile annular fold, behave with reagents like cellulose. To these statements I can add that this annular fold consists solely of cellulose, even before its extrusion.

In the ordinary course of development of *Edogonium*, this investigation is difficult, on account of the instantaneous rupture of the membranous envelope, and the sudden extension of the fully developed fold, on the application of the reagents necessary for these experiments.

In specimens placed in the direct rays of the sun, in order to excite them to more rapid development, but which had to support a temperature too high for their normal vegetative activity (namely, 35° Réaumur), the membranes of the secondary cells acquired considerable thickness whilst yet enclosed within the primary cells, which still exhibit their annular folds, as shown in fig. 25.

In these cells it could be seen distinctly that the annular constriction consists entirely of cellulose—that is to say, that it exhibits the cellulose reaction with solution of iodine and chloride of zinc—as the annular fold did not extend itself even on the application of that reagent.

The contents of these unusually thickened cells consisted of comparatively large hyaline non-nucleated cells, with pale-green starch- and chlorophyll-corpuscles and reddish-coloured oil-drops (?) thinly scattered between them. A large accumulation of chlorophyll was observed in the upper end of the cell.

These *Edogonia* soon became quite colourless; the large transparent vesicles disappeared; and only the oil-particles, and especially the decolorized starch-corpuscles, remained undissolved and unchanged in the dead membranes for any considerable time; even the annular fold vanished by solution, though the rest of the same cell-wall continued unaltered.

Similar individuals, with greatly thickened secondary cells, I have observed now and then among normally developed forms. In these also the annular fold had not expanded, though the investing envelope, consisting of a double membrane (probably the cuticle and the remainder of the membrane of a primitive mother cell), was annularly torn through above it. Indeed, in a few days, the fold was dissolved in the water, and its former existence evidenced only by an empty space. In these cells two young joint-cells had been formed—one, the larger, occupying the space below the annular fold, the other the small space of the mother cell above that fold. Both these young cells were

filled with secretion-vesicles; and occasionally I succeeded, by adding a thin endosmotic medium, in separating the two, not only from the wall of the mother cell, but also from one another; they contained all the chlorophyll present; and by the plan pursued the two endogenous membranes of the mother cell also became somewhat detached from each other.

In other joint-cells of the same individual, two young cells, alike in dimensions and position to those above described, were also present; but these could not be separated, by a similar proceeding, from one another, nor could the two endogenous membranes of the parent joint-cell be detached, or the existence of two superimposed cells be any longer distinguished with certainty. By the endosmotic current, however, a delicate daughter cell was detached from the thickened membrane of the new joint-cells, which was then recognized as the true immediate envelope of the endogenous secretory material.

These joint-cells therefore constituted a somewhat more advanced phase of development, as indicated also by the incipient thickening of their primary membrane.

As, in the cells just described, secretory matters occur not within the now rather thickened primary cells, but, as usual, only within the secondary cells, it might seem doubtful whether the outer membrane which was in course of thickening does actually represent an independently existing cell, or whether it might not probably be only an external thickened layer, transformed into cellulose, of the original cell-membrane, of which the remaining portion constitutes the inner, delicate, and probably still nitrogenous membrane.

In opposition to this view, which is by no means destitute of probability, and would give countenance to Mohl's theory that the inner secondary cell is of the nature of a primordial vesicle, several conclusive facts may be adduced. In the first place, it may be assumed, from the conditions of development above described (p. 282) and represented in Pl. VII. fig. 63, after treatment with glycerine, that here also the primary cell originally, or before the commencement of the thickening of its walls, contained secretory materials, then perhaps only in a fluid state, although these, at the time of observation, occurred within the secondary cell. A still more valid argument, though certainly resting only on analogy, is furnished by another developmental phase observed by me, wherein the primary cell-wall, instead of growing inwards so as to form the well-known annular fold, in the normal manner, produced (as seen in fig. 49) a fold extending downwards between the cell-walls of the mother and daughter cells.

This interesting condition was met with in several joint-cells

of filaments the other cells of which exhibited the normal annular folds; and I only noticed it with clearness after the action of solution of iodine and chloride of zinc upon the plant had tinted the deeply penetrating fold of the cell of a dark blue colour. By this means it was seen to extend very gradually and to outstretch itself, until it had fully emerged from the membranous sheath and became no longer distinguishable from a cell which had suddenly extended itself in the usual manner. The secondary cell was contracted around its contents, as is exhibited in Pl. VII. fig. 49; but sometimes also the chlorophyll and amylaceous contents expanded themselves and filled the whole of the lower space of the cell as far as the margin of the enveloping sheath.

This phenomenon I once observed taking place in several individuals of *Cedogonium grande* with great uniformity, and, as the evolution took place very slowly, with great certainty; but since then I have looked for similar examples in vain, and can therefore, much to my regret, contribute nothing further respecting the conditions under which this interesting act of fold-construction takes place.

Nevertheless it furnishes a fresh proof against the view spoken of—namely, that the cellulose membrane is the external thickening layer (or, as Mohl's school would represent it, excretory layer) of the secondary cell,—and can only be explained by the developmental faculty of the independently assimilating cell-wall.

Moreover the opinion that the normal annular fold is simply an excretion from the primordial sac is completely hypothetical. There is nothing to show that the secondary cell possesses in the portion contiguous to the ring any other or stronger powers of vegetation than in any other portions.

Besides the well-known and frequently described development of spores and gonidia, I also observed other organs, the functions of which are still unknown to me, but which, on account of their aberrant and strange developmental phenomena, certainly merit more general attention; for which reason I do not think I shall be accused of precipitancy for publishing here the little that I have observed respecting them.

Bary indeed appears to have met with something similar; for he has described and figured (Senckenberg Transactions, vol. i.) certain "globules of decomposition" (Zersetzungskugeln), which were produced from the joint-cells of dying specimens of *Cedogonium capillare*, *C. acrosporum*, and *C. echinospermum*. Bary saw the aggregated mass of contents form into a globule, and escape from longitudinal rents in a cell, commencing in the still unthickened and soft membrane of the recently extended annular fold. He more rarely noticed them escaping through the old and firm cell-membrane.

I have represented in Plate VII. the structures observed by myself, and which correspond in character with these globules of Bary. The phenomenon occurred in *Cedogonium grande*; the entire contents coalesced into a ball-like mass, which was protruded through a circular aperture in the thick-walled joint-cell, and formed on the outside a spore-like globule (Pl. VII. fig. 50). Alongside the opening there was a small disk, the size of the aperture, mostly adherent to one side of it, and which, without doubt, had originally closed it before being thrust out by the emerging cell-contents (fig. 50 d). The extruded, globular, spore-like corpuscle consisted of several nested cells, the two outer membranes of which frequently contained a single layer of small starch-vesicles, whilst the third was filled with chlorophyll and starch, and the fourth was occupied by reddish-brown vesicles.

The globular corpuscle was enveloped within a delicate transparent cell as in a sac, which was fixed by its lower and somewhat elongated extremity to the inner wall of the joint-cell near the circular aperture. Solution of iodine and chloride of zinc gave a beautiful violet-blue tint both to the saccular envelope and to the membrane of the globule. Bary did not remark this cellulose reaction of the enveloping sac; and in fact it is difficult to produce the coloration in the older globules which have been longer extruded from the mother cell. Yet, even under these circumstances, the true membranes of the globule are readily coloured blue. At a later phase of their development the starch-corpuscles vanish, and their walls become thickened and reticulate, or slightly porous (fig. 52).

The globule enclosed within the sac exhibits a mucilaginous peduncular body at its base, which is adherent, together with the lower end of the envelope, to the inside of the joint-cell. It appeared to me to be an inner envelope, which, however, is not so extended at this lower extremity as the outer one. The stem-like prolongation is also coloured blue by the same reagents.

Bary considers the saccular envelope to be a young membrane formed, probably at the time of extrusion, around the primordial sac, and continuous with the innermost layer of the emptied joint-cell. Consequently the outer membrane of the globule, or the delicate covering which in all probability serves as a lining to the sac and is prolonged into its pedicle, would be the secondary cell of the joint-cell.

For my own part, I have not witnessed the first act of coalescence of the cell-contents, but only the formation of such globules after they have begun to extrude from the circular aperture, and therefore have no knowledge of the origin of the different component membranes.

Many of the globules enclosed within the sac, although containing no starch, had somewhat stronger walls, not reticulate, but uniformly thickened. The chlorophyll- and starch-corpuscles enclosed within the third cell of the interior were present in smaller quantity; but, on the other hand, the mass of reddish-brown vesicles and granular mucilage in the fourth of those cells had increased, apparently at the cost of the secretory matters, especially of the chlorophyll, of the next adjoining external cell; this substance was in other instances entirely absorbed, and only the starch, in reduced quantity, left.

The red mass which occurs in the centre of the globule is usually at first not distinguishable through the chlorophyll, and probably is often altogether wanting, being only an accidental constituent, as in fact the future development tends to prove. Bary also describes the globules observed by him as brown, and as at length becoming of a dingy carmine-red colour.

I am unable to offer any interpretation of the purpose of this structure in plants. On account of the peculiar act of extrusion from the mother cell by means of the little lid which is always present, I am disposed to look upon the process as an independent and normal act of development, which, however, I have not been able to trace. On the other hand, I have noticed a very remarkable abnormal phenomenon in certain globules, the fourth internal cell of which was filled with red matter, which had more or less completely supplanted its vegetable secretory material. I have frequently seen such globules, whilst still enclosed within the sac and fixed to the joint-cell of the *Edogonium*, become slightly distended outwards at a particular point on one side, and an opening form at a corresponding point in the thickened outer envelope of the globule, as well as in the closely adherent membrane of the sac, to give a passage to the enclosed red mass. The body which escaped through this aperture was smooth and amœbiform, and forthwith assumed a spherical figure, enveloped by a colourless somewhat granular coat, from which long ciliary processes proceeded; these were not stiff, but moveable and capable of shortening or lengthening themselves. The globular body, apparently making use of these moveable ciliary processes as organs of adhesion, rolled slowly about in various directions. Fig. 53 shows a body of this kind, magnified 700 diameters.

In general, two or three such bodies emerged in succession from the opening in the globule, and I have often observed them moving, in the manner above described, for hours afterwards. The sac, with the thick adherent membrane of the globule, either remained altogether empty, or some starch and the second inner cell-membrane continued visible. The small orifice through which the little amœba-like beings had escaped

was only indistinctly perceptible. On three occasions I saw two of these globular ciliated bodies come into contact (fig. 54), adhere to each other, coalesce at the point of contact, and form a single motionless body. At the same time the whole of the cilia on the free surface very rapidly shortened, leaving the periphery completely smooth, whilst the granular colourless membrane became transparent, and constituted a structureless and rather thick envelope around the two coalesced bodies, which had now become completely united into a single, rather irregular, oblong body.

After a time this structure became flattened on the under surface; the red granular contents (of whose origin from two distinct masses no trace could any longer be discerned) now again underwent division into two portions, which were coated externally with red vesicles resembling oil-drops. Subsequently, within each of these segments, two globules separated, and in the place of these, again, numerous smaller ones made their appearance, a complete process of segmentation taking place, such as occurs in ova after impregnation. In consequence of this continued development of endogenous cell-generations, the object of which is doubtless the production of higher organic compounds, the thick-walled envelope, which is constantly undergoing certain changes of form, becomes now filled with a great number of small vesicles, which shimmer through the external red layer, consisting apparently of oil-drops, which lie immediately contiguous to the colourless membrane (Pl. VII. fig. 55). In the course of two days there is a distinct constriction of one half of the contents into several portions, as in the formation of an annulose animal (fig. 56).

The further development of the larva beyond this stage has mostly failed in my hands: in only one instance did it proceed to the third day; and even in this the animal escaped from the sac before its full form was visible (probably owing to the pressure of the glass cover, in consequence of the evaporation of the water around the object), in the shape and manner represented in fig. 57.

Unfortunately this phase of development is still so incomplete that it is not possible to determine accurately what animal it was. I am disposed to regard it as one of the Rotifera, of the genus *Rattalus*, specimens of which were abundant around. Nevertheless the above marvellous metamorphosis, followed out as it was for some time by myself, claims the attention of zoologists. I have to add to the foregoing fact, that a reddish-yellow-coloured *Amœba* is to be found living within the joint-cells of *Cedogonium* whilst still filled with chlorophyll, although more or less diseased, and that this being seems capable of

penetrating from one cell to another. As to any connexion between this *Amœba* and that which emerges from an apparent spore-capsule, and as to the nature and object of the ulterior conjugation and metamorphosis of the globules, I will not now hazard an hypothesis. The well-known large eggs of the Rotifera and Crustacea cannot be enclosed within these developmental structures. Lastly, I have made no researches respecting the construction of the lid-like covers of the apertures, which would still be particularly deserving of notice even if the capsule protruded from the joint-cell were found to be nothing more than a diseased product induced by the operation of the parasitic animal germ.

These researches were made in June and in the beginning of July; and I have been unable to verify them at a later period of the year.

[To be continued.]

XXVIII.—*Notes on the Byblus-Rush and the Byblus-Bok.*

By JOHN HOGG, M.A., F.R.S., F.L.S. &c.

IN a paper "On Vessels made of the *Papyrus*," which I communicated to the 'Magazine of Natural History' in 1829 (vol. ii. p. 324, &c.), I gave a sketch (fig. 88) of an ancient vessel used on the Nile in Egypt, taken from the famous Mosaic pavement discovered at Palestrina (Prænestæ), and which is constructed with a high and *long prow*. A kind of boat used on the large Lake Nyanza, in Equatorial Africa, is shown in Capt. Speke's 'Journal,' p. 391, as having a *prow* somewhat *similar* in length, and which he describes as "standing out like the neck of a syphon or swan."

This coincidence, then, is not unworthy of notice, as showing that, in all probability, the Nyanza boat retains the early form of that very ancient Nile vessel. Capt. Speke does not say of what materials the boat is composed, and whether the *Byblus-rush*, now abundant in that lake-district of Africa, is ever used in "filling up the joints on the inside," or for forming the ordinary "sails," as it was in the time of Herodotus (Euterpe, cap. 96).

The *Byblus-rush* (βύβλος of Herodotus, or the *Papyrus antiquorum* of Sprengel) was once so common on the banks of the Nile that Ovid assigned the epithet *Papyrifera* to that holy river. Nor was the plant itself esteemed *less holy*, inasmuch as it was used by the Egyptian priests for the ornamentation of their statues and temples, and for a frequent model of columns, and as a representative in the ancient hieroglyphics. But of late

years travellers have *not* found any of it in the *Lower Nile* and its adjacent waters; and thus have been confirmed these words of Isaiah (xix. 7), which allude to the Nile: "the *paper-reeds* (translated *πάπυρος* in the Septuagint) by the brooks.....shall wither, be driven away, and be *no more*." So it was with great pleasure that I recently read in Capt. Speke's 'Journal' of its vast abundance in the *Upper* or *White Nile* (the *Bahr el Abiad*) and in the many lakes near the equator. It seems also common in the Island of Zanzibar on the east coast, and along some of the rivers on the west side of Africa.

Capt. Speke (at p. 223) has well represented this noble and graceful rush, with its large panicle or head, in his plate of the "Little Windermere Lake," where its forest-like presence along the shores bears testimony to the accuracy of Cassiodorus's description of it (although hitherto considered by many scholars as an imaginary account) in this passage:—"surgit Nilotica sylva sine ramis, nemus sine frondibus, aquarum seges, paludum pulchra cæsaries" (lib. xi. cap. 88).

Signor Domenico Cyrillo published at Parma, in 1796, a splendid monograph of this Papyrus plant, with some large illustrations. When in Sicily, in May 1826, I saw it growing in luxuriance (but, I concluded, only *naturalized*) in the fountain of *Cyane* (La Pisma), which flows into the river Anapus to the south-west of Syracuse; and I understand it still flourishes in the same clear water. I made inquiry for it in Calabria, where, according to Linnæus and Persoon, it was mentioned as growing; but I could not ascertain the truth of its existence in that province. Some old authorities also related that it was indigenous in Syria; and I find that this has lately been confirmed by Dr. Hooker, who observed it a short time ago in the marshes and along the margins of the Lake Samachonitis, now *Bahr el Huleh*.

For a fuller account of the *Byblus*, and of its many former uses, I may refer the reader to my work on the "Classical Plants of Sicily," originally published in Sir William Hooker's 'Botanical Journal,' 1834.

In the same plate of Speke's sketch, that excellent animal-artist, Mr. Wolf, has given the figures of a fine Antelope, called *Nsoé*, or "Water-Bok." The male of this species bears a pair of noble, long, twisted horns; and he is said to be "closely allied to a *Water-bok* found by Dr. Livingstone on the Ngami Lake." It is an aquatic species; and, from living in the moist element, the hair of its coat is "long, and of such excellent quality that the natives prize it for wearing almost more than any other of the Antelope tribe." Its chief food being the long filaments of

the panicles of the *Byblus-rush*, in order to record this interesting fact in connexion with so important an African plant as the *Papyrus* or *Byblus*, I should prefer to call this new Antelope *Tragelaphus byblopheus* instead of "*T. Spekii*," the name suggested by Dr. P. L. Sclater. Another character of this animal is very worthy of note—namely, the extreme length of the *toes* or fore parts of the hoofs, so that "it could hardly walk on the dry ground," but of course most useful for traversing the mud and marshy shores of the lakes. This provision of nature reminds me of the *long toes* of the Water-rail, Gallinule, and other kinds of the family *Macrodyteli* of Cuvier, which he characterizes as having "*les doigts des pieds fort longs et propres à marcher sur les herbes des marais*;" and in like manner, it adapts that Antelope to walking over, and being supported upon, the long stems of the *Byblus-rush* and other fluviatile "plants so densely interwoven in the waters"—or, in the exact words of the philosopher Seneca (*Nat. Quæst. lib. vi. cap. 8*), "*ita implicitæ aquis herbæ*"—not only of the Upper Nile itself, but also of the reservoir-lakes which feed that mighty and sacred river.

Feb. 19, 1864.

XXIX.—*Observations on Raphides and other Crystals.*
By GEORGE GULLIVER, F.R.S.

[Continued from p. 215.]

Smilacææ.—The following officinal drugs were obtained from the authentic dispensary of the Society of Apothecaries, through the courtesy of its worthy treasurer, Mr. Ward:—Red Jamaica Sarza, Honduras Sarza, Guatemala Sarza, and solid extract of Sarza. All the three roots abounded in raphides, generally seen within oblong cells, which, in the Guatemala specimen, often appeared as beautiful chains along the liber. This sample was remarkable for the scantiness of its starch, scarcely a trace of which could be detected; while the Red Jamaica and Honduras abounded in starch-granules and their cells. In the extract no raphides could be found; but it contained numerous quadratic octahedrons, about $\frac{1}{1000}$ th of an inch in diameter, and exactly resembling those microscopic crystals which have been usually regarded as composed of oxalate of lime. These crystals are most easily found by diluting the extract with water, and then letting them subside to the bottom for collection. The examination of the officinal American sort will be found noted under *Araliacææ*.

Dioscoreacææ.—In all the few species yet examined we have

seen the abundance of raphides. And they are plentiful in the root, stem, leaves, and decayed flowers of *Testudinaria elephantipes*.

Trilliaceæ.—Fresh and dried plants of *Paris quadrifolia*: bundles of raphides plentiful in leaves, sepals and petals, anthers and filaments, testa and berry-coat. Unexpanded flower of *Trillium grandiflorum*: raphides scanty in ovule, but bundles of them very numerous in ovary, styles, stamens, corolla, calyx, and flower-stalk.

Zingiberaceæ.—Fresh leaves of *Amomum* (*A. cinnamomum*?) and of *Hedychium Gardnerianum*; and dried Cardamoms of the shops: no raphides; only a few minute lozenge crystals, like those of *Aurantiaceæ*, in the leaves and dried capsules.

Marantaceæ.—Leaves of *Canna Indica* and *C. iridiflora*: a few of the lozenge crystals, but no raphides.

Iridaceæ.—To the plants before mentioned ('Annals,' Sept. 1863) may be added *Gladiolus insignis* and *Iris pumila* as affording excellent examples of the crystal prisms. Most of these crystals have four, and a few three, angles; their average length is $\frac{3}{16}$ th and their thickness $\frac{1}{16}$ th of an inch; they abound in the leaves of both species, and were seen in the roots of *Iris pumila*.

Amaryllidaceæ.—*Clivia nobilis*: raphides abundant and very small near the base of the leaf, but very scarce in it elsewhere. *Narcissus poeticus*, *N. biflorus*, and the garden Jonquil or Campanelle: leaves, bulbs, and roots abounding in raphides.

Liliaceæ.—Leaves of *Dracena terminalis*, *Muscari*, sp., *Tritoma Uvaria*, and *T. media*: numerous raphides and larger crystal prisms. Leaves of *Lachenalia tricolor*, *L. pendula*, and *Asphodelus luteus*: raphides plentiful. Of the species of *Allium*, though I have examined several once and others repeatedly (viz. *A. Ascalonicum*, *A. Cepa*, *A. Porrum*, *A. sativum*, *A. Schænoprasum*, *A. angulosum*, *A. magicum*, *A. Moly*, and *A. ursinum*), true raphides were not found in any one of these plants; but a section of the genus, as observed in the above first four species, is characterized by an abundance of crystals in the bulb-scales—right-angled four-sided prisms, the ends either obtusely truncated or with very low four-sided pyramids; mostly occurring singly, sometimes two, three, or four stuck together, occasionally forming crosses; always (unlike true raphides) difficult to detach from each other and from the tissue in which they are imbedded; commonly about $\frac{3}{16}$ th of an inch long and $\frac{1}{16}$ th thick; well seen in the peel of the officinal Shallot, in which they are very plentiful, and slightly larger than in the Onion, Garlic, and Leek.

Melanthaceæ.—In this order, also, some species are as con-

stantly abundant raphis-bearers as others are not so. *Veratrum nigrum* and *V. album* (roots and young leaf-buds): numerous bundles of raphides in delicate hyaline cells; in the leaves also a sphæraphid tissue, each of the sphæraphides about $\frac{1}{100}$ th and its cell $\frac{1}{100}$ th of an inch in diameter. *Helonias bullata* (leaf): raphides very scanty. *Colchicum autumnale* and *Bulbocodium vernum*: leaves and bulbs destitute of raphides; but numerous faint and minute raphis-like objects, about $\frac{1}{100}$ th of an inch long and $\frac{1}{100}$ th thick, in roots; no crystals in bulb-scales. *Tofieldia palustris* and *T. pubescens*: no raphides in leaves or roots.

Commelinaceæ.—Raphides abundant in the leaves of *Tradescantia Virginica*.

Butomaceæ.—Roots and subterranean buds of *Butomus umbellatus*: no raphides; tubers made up chiefly of starch, and their pulpropy and immiscible with water.

Araliaceæ.—Subterranean stems known as wild or American Sarza (*Aralia nudicaulis*), obtained from Messrs. Butler and McCulloch: was plentifully studded in the liber and pith with sphæraphides, averaging $\frac{1}{100}$ th of an inch in diameter; but neither starch nor raphides were seen. *Hedera Helix*: no raphides.

Aurantiaceæ.—I have seen no raphides in this order; but it abounds in crystals about $\frac{1}{100}$ th of an inch long and $\frac{1}{100}$ th broad, as may be well seen in the leaves and petioles of *Citrus vulgaris*, *C. decumana*, *C. Aurantium*, and *C. myrtifolia*; the crystals sometimes nearly square, but commonly lozenge-shaped, single or double octahedrons, and more rarely twin-formed, like the crystals which have been described in many other plants as sulphate of lime.

To Mr. Ward, Mr. De Carle Sowerby, Mr. Cox, and Mr. W. H. Baxter I am indebted for generous aid in the prosecution of the observations in this paper. The results will be examined when a survey is made of the whole series. Meanwhile it may be noted that this portion shows different species of one order (as *Allium* and *Muscari*) growing close together in the very same soil of my garden, and yet the former plant as constantly devoid of raphides as the latter is pregnant with them—the first three orders of Monocotyledones abounding in raphides, which suddenly disappear in the fourth order (*Hydrocharidaceæ*) to reappear in the next succeeding one; and the equally curious difference in sections of *Melanthaceæ*—*Veratrum* with its swarms of raphides, and their deficiency in *Colchicum*, *Bulbocodium*, and *Tofieldia*. Surely such facts are sufficient to show what a vast and interesting field of plant-life lies barren to us from want of

cultivation; the improvement of which, with the aid of the chemist, might be expected to afford important results for botany and physiology.

Edenbridge, March 8, 1864.

[To be continued.]

XXX. — *A Description of, and Remarks upon, some Fossil Corals from Sind.* By P. MARTIN DUNCAN, M.B. Lond., F.G.S. &c.

[Plates XVIII. & XIX.]

It must be evident to all who have studied the distribution of the Corals of the Secondary and Tertiary formations, that the Eocene Coral-Fauna is very poor in genera, and that it is much less important than those of the lower Cretaceous and the Miocene strata. The comparative scarcity of Eocene Corals rendered M. J. Haime's description of seventeen species from the Nummulitic formation of Sind of great interest, especially as several of them were well known in the French and Savoyard Nummulitic strata, and also because a new genus was added to the fauna*. Since the decease of this gifted naturalist, a part of the Blagrove Collection belonging to the Geological Society of London has remained undescribed†; and a very fine series of Corals from Kurrachee, in the British Museum, also. I was tempted to search for new forms, and found many more than I had anticipated; but all of them are not of Eocene age. MM. d'Archiac and J. Haime appear to ignore the Miocene in the great chain of hills which extends from the "Salt range" almost due south to Kurrachee; but the memoir written by Grant‡, and illustrated by Sowerby, strongly advocates the existence of more than one Tertiary formation of marine origin. The discovery of three fossils from Kurrachee identical in species with common forms of the Nivajé shale of San Domingo leaves no doubt in my mind that several of the species about to be noticed ought to be separated from the Eocene Coral-fauna.

The following list embraces all the species as yet found in Sind; and I have appended the other localities where they have been observed. The species which came under M. J. Haime's observation are also noticed.

* Descrip. des Anim. Foss. du Groupe Nummul. de l'Inde, par MM. d'Archiac et Jules Haime, 1853.

† See my note on the Sindian Fossil Corals, 'Quart. Journ. Geol. Soc.' vol. xx. 1864, p. 66.

‡ Trans. Geol. Soc. ser. 2. vol. v. 1837.

List of Fossil Corals from Sinde.

Name.	Locality in Sinde.	Other Localities.
21. <i>Trochocyathus Burnei</i> , J. Haime	Hala Mountains	La Palarea, Europe.
2. — <i>Van-den-Hecke</i> , J. Haime	" "	La Palarea, Annot, Europe.
3. — <i>cyclotoides</i> , J. Haime	Cutch	Vicentin, Corbières, La Palarea, Europe.
p†4. — <i>sinuosus</i> , Edwards & Haime	Hala Mountains	La Palarea, Europe.
5. <i>Ceratocyathus exaratus</i> , Edwards & Haime	" "	La Palarea, Corbières, Europe.
††6. <i>Oculina Halensis</i> , n. sp.	" "	La Palarea, Europe.
7. <i>Stylophora contorta</i> , Jules Haime	" "	La Palarea, Europe.
8. <i>Trochomilia corniculum</i> , Edwards & Haime	" "	Paris, Bracklesham, La Palarea, Europe.
9. — <i>multisinuosa</i> , J. Haime	" "	La Palarea, Europe.
10. <i>Stylococenia emarcata</i> , D'Orbigny	" "	Castel Gomberto, Europe.
11. — <i>Vicaryi</i> , J. Haime	" "	La Palarea, Coustonge, Europe.
12. <i>Phyllococenia irradians</i> , Edwards & Haime	" "	
†13. — <i>Lucasana</i> , Edwards & Haime	" "	
†14. — <i>conferta</i> , n. sp.	" "	
†15. <i>Astrococenia Caillandi</i> , Edwards & Haime	" "	
*†16. <i>Desyphyllia gemmans</i> , n. sp.	" "	
†17. <i>Montlivaltia brevis</i> , n. sp.	" "	
18. — <i>Granti</i> , J. Haime	" "	
19. — <i>Jacquemont</i> , J. Haime	" "	
20. — <i>Vignei</i> , J. Haime	" "	
§††21. <i>Antilia ponderosa</i> , nobis	" Sinde Tertiaries	Jamaica, San Domingo, Guadalupe. (West-Indian Miocene.)
††22. — <i>dentata</i> , nobis, var.	" "	San Domingo. (West-Indian Miocene.)
††23. — <i>plana</i> , n. sp.	" "	

*† 24. <i>Cladocora Haimi</i> , n. sp.	"	"	Val de Ronca, Europe.
† 25. <i>Hydnophora rudis</i> , n. sp.	"	"	
† 26. — <i>Dane</i> , n. sp.	"	"	
† 27. — <i>plana</i> , n. sp.	"	"	Hala Mountains
† 28. — <i>hemisphaerica</i> , n. sp.	"	"	"
† 29. <i>Solenastrea</i> — sp. ?	"	"	"
30. <i>Siderastrea funesta</i> , Edwards & Haime	"	"	"
31. <i>Cyclolites Vicaryi</i> , J. Haime	"	"	"
† 32. <i>Cycloseris Perezi</i> , J. Haime	"	"	Sindh Tertiaries
† 33. <i>Trochoseris aperta</i> , n. sp.	"	"	"
† 34. <i>Cyathoseris Valmondosica</i> , var., Edwards & Haime	"	"	"
† 35. — <i>irregularis</i> , n. sp.	"	"	"
† 36. — <i>magnifica</i> , n. sp.	"	"	"
*† 37. <i>Mycedium costatum</i> , n. sp.	"	"	"
*† 38. <i>Agaricia agaricites</i> , Edwards & Haime	"	"	"
39. <i>Pachyseris Murchisoni</i> , J. Haime	"	"	San Domingo, American Seas. (West-Indian Miocene and recent.)
*† 40. — <i>rugosa</i> , Edwards & Haime	"	"	St. Bonnet, Europe.
*† 41. <i>Porites incrustans</i> , Edwards & Haime	"	"	Recent, Pacific.
	"	"	Turin, Bordeaux, Dax, Vienna, San Domingo. (Europe and West-Indian Miocene.)
*† 42. <i>Coralium pallidum</i> , Michelotti	"	"	Turin Miocene, Europe.

† Corals not noticed by M. J. Haime or by any other geologist.

* Corals certainly not pertaining to the Eocene fauna.

α Animaux fossiles de l'Inde, D'Archiac & Haime.

† Histoire Naturelle des Coralliaires, Milne-Edwards and J. Haime, vol. ii.

§ "On the Fossil Corals of the West Indies," Proc. Geol. Soc. vol. xix. 1863.

1. *Trochocyathus sinuosus*, Edwards & Haime.

A young specimen of this gigantic species is amongst the Sind Collection in the British Museum. Locality, Kurrachee. European localities, La Palarea, Vicentin, Corbières (Eocene).

2. *Oculina Halensis*, n. sp. Pl. XVIII. fig. 1.

Corallum branching, the terminal branches being straight, tapering, and cylindrical. The calices are very prominent, and project obliquely; they are arranged in four parallel series, two being on opposite sides of the corallum. The calices of the opposite series are on the same level, and those of the intermediate pair are midway; consequently there is more or less of a spiral distribution. The calicular edges are rather sharp, and the costæ are continued down the projection, but not on to the cœnenchyma, which is faintly granular. The septa are small, and form six systems; there are three cycles generally. The laminæ are barely exsert, and the primary septa are stout. The pali are very small, being appended to the first and second orders of septa. The columella is small. Occasionally there is a fissiparous growth. Diameter of branches $\frac{1}{16}$ – $\frac{1}{8}$ inch. Projection of calices $\frac{1}{16}$ – $\frac{1}{8}$ inch; breadth of calices $\frac{1}{16}$ – $\frac{1}{8}$ inch.

Locality, Sind Tertiaries. Coll. Geol. Soc.

This species, from its granular cœnenchyma and short costal striæ, is more closely allied to the Eocene *Oculina conferta* than to any others of the genus; but the shape of the corallum and the lateral and very prominent calices are sufficient to distinguish the new species from any other; but they bring it into alliance with forms later than the Eocene.

3. *Phyllocœnia conferta*, n. sp. Pl. XVIII. fig. 2.

The corallum is flat, slightly convex above and gibbous below. The corallites are short, distinct, crowded, occasionally deformed, and generally variable in size. The calices are circular or elliptical, and irregular in shape; they are barely exsert, are very shallow, differ in size, but have well-developed costæ, feebly developed septa, and rudimentary columellæ. There is a small amount of cœnenchyma between some corallites. The costæ are close and crowded, a little inclined, not dentate, but simply ridged; and according to the paucity of septa in the corallites, so are the costæ unequal in size. In fully developed corallites the costæ are subequal; but in the majority the alternate costæ are the longest, although the intermediate, which correspond to small septa, are often the thickest. The septa are more delicate than the costæ, are hardly exsert, but dip at once downwards and inwards; they are generally alternately large and small,

the latter being often rudimentary. There are six systems and three cycles, but many of the oval and irregular calices have some orders of the fourth cycle in some systems. There is either no columella or simply the rudiments of one. Diameter of the calices $\frac{3}{8}$ — $\frac{1}{2}$ inch, of oval calices $\frac{1}{4}$ inch.

From the Sind Tertiaries, Kurrachee. Coll. Brit. Mus.

This species belongs to the *Phyllocenia* with crowded costæ, and is therefore closely allied to *P. compressa* and *P. sculpta*. Its crowded calices distinguish it from the last species, and the slightly exsert calices distinguish it from the first. The crowded costæ, close and slightly exsert calices, and the flat form together distinguish this species from any of those already known.

4. *Phyllocenia Lucasana*, Edwards & Haime.

A specimen of this Coral is in the Coll. Geol. Soc. Locality, Sind Tertiaries.

The species is found in Europe at Castel Gomberto (Eocene).

5. *Astrocenia Caillaudi*, var., Edwards & Haime.

A magnificent specimen of this species is in the British Museum. It simply differs from the type in its large calices and general luxuriance of growth.

Locality, Sind Tertiaries. Europe, at La Palarea and Coustonge.

6. *Dasyphyllia gemmans*, n. sp. Pl. XVIII. fig. 3.

The corallites are long, slender, close, slightly compressed and more or less flattened here and there. The "frills" can be traced inferiorly. The calices are compressed, rather deep, and present a central and well-developed columella. The septa are long, delicate, and numerous; there are four cycles, and the third order of septa joins the second close to the columella. The costæ, although much worn in the specimen, are subequal; and many are rudely spined, especially near the calices and externally. There are numerous lateral buds, and the corallites appear to be joined by extraneous matter and by offshoots of the rudimentary epitheca. Height of corallites 8 inches. Length of calice $\frac{1}{2}$ inch; breadth of the calice $\frac{1}{4}$ inch.

Locality, Sind Tertiaries. Coll. Geol. Soc. and Brit. Mus.

There are three species of this genus described by Edwards and Haime—the recent *D. echinulata* of Singapore, the *D. Michelii* of the Bormida Miocene, and the *D. Taurinensis* (*Lobophyllia contorta*, Michelin) of the Turin Miocene.

The new species is closely allied to *D. echinulata*, differing from it, however, in the height and flattened form of the corallum, the slightly projecting and barely spinous costæ, together

with the numerous buds. It is distinct from the Miocene species.

7. *Dasyphyllia* —, sp. ?

Several specimens of a species of this genus, with collared eminences, are in the British Museum as well as in the Geol. Soc. Coll.

8. *Montlivaltia brevis*, n. sp. Pl. XVIII. fig. 4.

The corallum is short, and has a large base, which equals the calice in diameter. The calice is very nearly circular and very shallow. The septa are crowded, thin, and long; and there are five cycles of them, with occasional orders of a sixth; the higher orders are small, and extend but a little way from the wall, while the larger septa meet nearly in the centre of the calicinal space. The septa are evidently not very exsert. The costæ are distinct, parallel, and generally equal: close to the calice they appear to have been dentate; but elsewhere, the presence, and the evidences of the former existence, of an epitheca render them more or less indistinct. There are traces of an exotheca. Height of corallum $\frac{1}{6}$ — $\frac{1}{5}$ inch. Breadth of calice 2 inches.

From the Sinde Tertiaries. Coll. Geol. Soc.

This species is very closely allied to *M. sessilis* (*Anthophyllum*, Goldfuss), and less so to *M. detrita*.

9. *Antillia plana*, n. sp. Pl. XVIII. fig. 5.

The corallum is very short, and has a flat base, which equals the calice in diameter. The calice approaches somewhat the figure of 8, is stout at the margin, rather shallow, and presents a prominent circular parietal columella. The septa are crowded at the margin, but less so close to the columella; the primary are the largest, being not much larger, however, than the secondary; the tertiary are delicate, and reach, with those already noticed, to the columella. The higher orders of septa are small, and in some systems the highest are rudimentary. There are five cycles of septa, in six systems. The costæ are of two kinds—one subequal and large, the other very small and only reaching a little distance from the calicular margin. The columella is lax, large, and occupies some space, being also nearly circular. The greatest depth of the calice is a little external to the columella. The epitheca is noticed here and there, but generally the distinct and rather prominent plain costæ are uncovered by it. Height of coral $\frac{3}{16}$ to $\frac{1}{4}$ inch. Width of the calice $\frac{1}{8}$ inch; length of the calice $\frac{1}{8}$ inch.

From the Sinde Tertiaries. Coll. Geol. Soc.

The shape and large fixed base distinguish this species. It is allied to *A. ponderosa*.

10. *Antillia dentata*, var., nobis.

Quart. Journ. Geol. Soc. vol. xx. p. 29.

The coral has a broad base; the epitheca is well developed, and the columella also.

From the Sinda Tertiaries, Kurrachee; also from Jamaica (Miocene). Coll. Brit. Mus.

11. *Antillia ponderosa*, nobis.

Montivaltia ponderosa, Edwards & Haime.

A small and worn specimen is in the British Museum.

Sinde. Jamaica, Guadaloupe, and San Domingo (Miocene).

12. *Cladocora Haimeii*, n. sp. Pl. XVIII. fig. 6.

Corallites long and very slightly flexuous: the buds are few, and leave the parent singly at an acute angle, but often become attached to it again. Calice circular. Septa small and delicate, the larger being much smaller than their costæ. Three cycles are generally complete, and the septa of the third order are smaller than the others. In one specimen the septa are crooked, most probably from post-mortem pressure from without. Columella small, and the pali also. Costæ alternately large and very small, there being twelve large and usually twelve small; the larger are much produced. Width of calice and of large corallites $\frac{1}{10}$ inch.

The species is more closely allied to *Cladocora manipulata* and *C. Michelottii*, Edw. & Haime (both Miocene forms), than to any others.

13. *Hydnophora rudis*, n. sp. Pl. XIX. fig. 1.

Corallum thick, its upper surface more convex in the middle than at the sides, and covered by numerous monticules of many shapes and sizes, whose base is usually flat, and whose upper extremity is generally sharp, cristiform, and irregular in its direction. The larger monticules are compressed, inclined, and sharp, whilst the smaller are conical. The septa are numerous, very slightly projecting, equal, and usually enlarged at their inferior extremity. The costæ are seen on the under flat surface of the corallum as faint parallel lines, and are alternately large and small. Width of the valleys from $\frac{1}{4}$ – $\frac{1}{3}$ inch; height $\frac{1}{10}$ – $\frac{1}{6}$ inch; ten septa in $\frac{1}{2}$ inch. Thickness of corallum $\frac{3}{4}$ – $1\frac{1}{2}$ inch.

The species is closely allied to the next, to *H. plana*, and to the recent *H. Demidoffi*, Fischer.

Kurrachee. Coll. Brit. Mus.

14. *Hydnophora Danae*, n. sp. Pl. XIX. fig. 2.

The corallum is tall, very thick, and its upper surface is small

and flat. The monticules are very small, and are much less than the corallites; they resemble small insects, are compressed laterally, very slightly elevated, and are wide apart. The septa are numerous, and the longest arise from the middle of the monticule; they are alternately very short and long, and are often enlarged at the free extremity, but otherwise are straight and thin. Height of corallum $3\frac{1}{2}$ inches. Length of monticules $\frac{1}{10}$ inch, breadth $\frac{1}{30}$ inch; width of series $\frac{1}{10}$ — $\frac{1}{20}$ inch.

Locality, Sinde Tertiaries. Coll. Geol. Soc.

The minute monticules, their compressed form, and septal arrangement distinguish this species.

15. *Hydnophora plana*, n. sp. Pl. XIX. fig. 3.

Corallum foliaceous; its upper surface level, and marked by numerous conical monticules rather inclined and often in parallel series, whilst the lower is indistinctly marked by faint costæ. The monticules are irregular in size, rarely thin above, often compressed in the direction of the series, and varying in height. The septa are distinct, and a large one is usually succeeded by a smaller. Width of the valleys $\frac{1}{2}$ inch, depth $\frac{1}{3}$ inch; ten large and ten small septa in $\frac{1}{2}$ inch.

Locality, Sinde Tertiaries. Coll. Geol. Soc.

This species is allied to two recent species, but has only a generic affinity with the Eocene *Hydnophora Bronni* and with the next form described. The alliance with *H. Demidoffi* and *H. exesa* is close: they are both from the Indian Ocean.

16. *Hydnophora hemisphærica*, n. sp. Pl. XIX. fig. 4.

Corallum irregularly hemispherical, concave below, and very convex above. Monticules very irregular in size and shape: the majority very small, and conical; the rest either larger and conical, or large and very long in the direction of the series, and all appearing to have been sharp at the summit, and rarely compressed. The septa are numerous, delicate, alternately large and small, and crowded. Width of valleys $\frac{2}{3}$ — $\frac{1}{2}$ inch. Height of monticules $\frac{1}{2}$ inch. Height of corallum, $1\frac{2}{3}$ inch.

Locality, Sinde Tertiaries. Coll. Geol. Soc.

This species belongs to the same section as the Eocene *H. Bronni*, but is readily distinguished from it: however, this is the closest alliance it has.

17. *Solenastræa*, sp.

A rolled specimen of a new species of this genus in the British Museum is too much worn for a correct diagnosis to be made. It is easily distinguishable from *S. Verhelsti*. Locality, Sinde Tertiaries.

18. *Trochoseris aperta*, n. sp. Pl. XIX. fig. 5.

The corallum is simple, conical, and short; it is circular and nearly flat above, except at the fossa, but slightly pedunculated inferiorly. The upper surface consists of a central, irregularly circular, and deep fossula, surrounded by a subplane and wide rim, which is marked by numerous and slightly exsert septal prolongations. The external edge of the rim is sharp and is in contact with the epitheca, which is marked slightly by the costal continuations of the septa of the rim. The fossula contains the projecting primary septa, a small flat columella, and the numerous small septa. The septa are in six systems; and in calculating the cycles the horizontal septa of the rim must be considered, although all of them do not reach the fossula. The cycles are irregular, and there are five, with several septa of the sixth. The primary septa are the thickest, and project most into the fossula; but they and all the others are very slightly exsert, and the spaces between them are either closed (as on the rim) by a horizontal floor which hides the numerous synapticulæ, or (as in the fossula) by the synapticulæ. The primary septa, where projecting, are granulated laterally. The secondary septa are distinguishable within the fossula, but not on the rim. The septa of the highest orders extend only a slight distance from the external edge of the rim, and all are more or less dentate. The costæ are faint elevations covered with epitheca. The synapticulæ are very numerous. Height of coral 1 inch. Width of upper surface $1\frac{2}{6}$ inch., of the fossula $\frac{1}{6}$ inch; depth of fossula $\frac{1}{6}$ inch.

From the Sind Tertiaries, Kurrachee. Coll. Brit. Mus.

The form would resemble a large pedunculated calice of a *Mycedium* with a circular rim including the costæ. I do not consider, however, that it is the parent calice of a compound species. It has only a slight affinity with *Trochoseris distorta* of the French Eocene.

19. *Cyathoseris Valmondoisiaca*, var., Edwards & Haime.

The variety has a broader base and a greater disposition to run into series as regards the calices than the type. The synapticulæ are numerous, and the "collines" are well developed. The species is found in the French Eocene at Auvert, Valmondois, Assy, and Bouconwilliers. (See Michelin, Icon. Zooph. p. 155; D'Orbigny, Prod. t. ii. p. 426, 1850.) The variety, which resembles a *Manicina*, is from the Blagrove Collection of the Geological Society, and is found in the Hala Mountains.

20. *Cyathoseris irregularis*, n. sp. Pl. XIX. fig. 6.

The calices are separated by cristiform walls, and are large

and open in most cases. The outer part of the calice is more or less separated from the inner, and the septa are wide apart, very distinct, and more or less dentate. The costæ on the plicated external wall of the corallum are distinct, large and irregular in size. The synapticulæ are wide apart and distinct. Peduncle not wide. Height of coral $\frac{1}{2}$ inch. Width of a calice $\frac{1}{16}$ inch.

Locality, Sinde Tertiaries. Coll. Brit. Mus.

This species is readily distinguishable by its calices and large irregular costæ; and its calices resemble those of *Trochoseris aperta* in many respects. When worn and deprived of its "collines," this species presents the appearance of a series of cup-shaped depressions with wide interspaces. See specimen in Coll. Geol. Soc.

21. *Cyathoseris magnifica*, n. sp. Pl. XIX. fig. 7.

The corallum is large, convex, and irregularly rounded above, and trochoid, with a small attachment below; the wall is ranged in rounded folds which do not much affect the calicular surface, and it is very faintly costulated. The calicular surface is very Astræan in its appearance; the synapticulæ between the septa determine the family, however. Calices unequal and irregular in shape, simple, not in series, varying in depth, and all more or less infundibuliform; they are separated by a cœnenchyma, which is more or less marked by the costæ, and they are imbedded and are not exsert. The septa are numerous above, but are grouped in paliform masses in contact with the broad flat columella. The wall is thick. Height of corallum $2\frac{1}{16}$ inches, breadth $3\frac{1}{16}$ inches. Breadth of a calice $\frac{1}{16}$ — $\frac{1}{8}$ inch.

Locality, Sinde Tertiaries, Kurrachee. Coll. Brit. Mus.

The convex upper surface, with its crowd of deep calices, distinguishes this species, which is widely separated in its septal arrangement from all the others.

22. *Mycedium costatum*, n. sp. Pl. XIX. fig. 8.

The corallum is in rather thick frondiform expansions, whose under surface is marked by long, parallel, straight, equal, and slightly prominent smooth costæ, and whose upper surface presents calices more or less inclined, a little raised on one side, often deep, separate generally, or occasionally placed on mammillated elevations. The septa are thick at the calicular margin, delicate within, and are continuous with long, parallel, distant, subequal costæ, which are regularly dentate. The columella is very small, and there are two or three cycles of septa. The blunt teeth of the costæ are not restricted to the neighbourhood of the calices. Thickness of corallum $\frac{1}{16}$ — $\frac{1}{8}$ inch. Costæ eight in $\frac{1}{16}$ inch.

From the Sinde Tertiaries. Coll. Geol. Soc. and Brit. Mus.
This is the first instance of a fossil *Mycedium*; and the species* is more closely allied to the *Mycedium Okeni* (recent, habitat unknown) than to any other. The parallel, nearly equal, and dentate costæ distinguish the fossil form.]

23. *Pachyseris rugosa*, Edwards & Haime.
Hist. Nat. des Corall. vol. iii. p. 85.

A fossil, tolerably well preserved, must be referred to this species, which Michelotti is said to have found fossil on the shore of Cuba, and which inhabits the South Seas.

Locality, Sinde Tertiaries. Coll. Geol. Soc.

24. *Agaricia agaricites*, Edwards & Haime.

The specimen in the British Museum cannot be distinguished from one in the Coll. Geol. Soc., from the San Domingan Miocene.

Locality, Sinde Tertiaries. West Indies, recent. San Domingo, Miocene.

25. *Porites incrustans*, Edwards & Haime.

Porites Collegniana, Michelin; Reuss.

A well-marked specimen of this species, which is found in the European Miocene of Turin, Bordeaux, Dax, Carry, Vienna, Hungary, and in the San Domingan shales, is amongst the fossils from Kurrachee, Sinde. A worn specimen is in the Coll. Geol. Soc.

26. *Corallium pallidum*, Michelotti.

The specimen of this species is of a pale rose-colour, and the striæ are very well developed. The species is hardly separable from *Corallium rubrum*.

Locality, Sinde Tertiaries. In Europe, in the Turin Miocene. Coll. Geol. Soc.

General Remarks.

The specimens in the Geological Society's Museum and in the national Collection are tolerably perfect, and present two forms of mineralization, one of which is distinguished by its dark-red colour, and the other by its paler tint. As a rule, the darker-coloured corals are the oldest; but, as there are several exceptions to the rule, colour cannot be employed in distinguishing the Eocene from the Miocene forms.

Amongst the species common to the Sindian and European Eocene, and which were not noticed by M. J. Haime, *Trocho-*

cyathus sinuosus and *Astrocaenia Caillaudi* are the most remarkable: the first is subject to some variation in its form, like all simple Corals, but the specimen from Sinde is, even in its mineralization, undistinguishable from others found in the Maritime Alps of Europe; and the last is a gigantic specimen, with very remarkable, thick inner terminations to its principal septa. The specimen of *Cyathoseris Valmondoisiaca* is very like the drawing of the French form by Michelin.

It must suffice to assert the strong probability of the new species being of more than one Tertiary age, until careful collectors transmit specimens with their localities marked on the geological maps. The new Eocene species would appear to be:—*Phyllocenia conferta*, *Montlivaltia brevis*, *Hydnophora rudis*, *H. Danae*, *H. plana*, *H. hemisphaerica*, *Trochoseris aperta*, *Cyathoseris irregularis*, and *C. magnifica*. The Miocene species are probably *Dasyphyllia gemmans*, *Antillia dentata*, *A. plana*, *A. ponderosa*, *Mycedium costatum*, *Agaricia agaricites*; and *Porites incrustans*; and the *Oculina Halensis*, *Cladocora Haime*, *Pachyseris rugosa*, and *Corallium pallidum* are either of a late Miocene age or of a still later geological epoch.

EXPLANATION OF THE PLATES.

PLATE XVIII.

- Fig. 1. *Oculina Halensis*: *a*, terminal portion of a branch, natural size; *b*, side of calice, magnified 6 diameters.
 Fig. 2. *Phyllocenia conferta*: *a*, corallum, natural size; *b*, calices, magnified 6 diameters.
 Fig. 3. *Dasyphyllia gemmans*: *a*, corallum, one-half the natural size; *b*, part of corallum, natural size, showing the aborted branches and the worn costæ; *c*, calice, natural size.
 Fig. 4. *Montlivaltia brevis*: *a*, corallum, natural size; *b*, side views of portion of the corallum, showing the epitheca and costæ, magnified 2 diameters.
 Fig. 5. *Antillia plana*: corallum, showing the columella, natural size.
 Fig. 6. *Cladocora Haime*: *a*, portions of a corallum, natural size; *b*, calice, magnified 6 diameters.

PLATE XIX.

- Fig. 1. *Hydnophora rudis*: *a*, part of calicular surface, natural size; *b*, monticules, magnified 2 diameters.
 Fig. 2. *Hydnophora Danae*: side view of corallum, one-third the natural size; *a*, monticule, magnified 4 diameters.
 Fig. 3. *Hydnophora plana*: *a*, part of calicular surface, natural size; *b*, monticules, magnified 4 diameters.
 Fig. 4. *Hydnophora hemisphaerica*: monticules magnified 4 diameters.
 Fig. 5. *Trochoseris aperta*: *a*, calicular surface; *b*, side view of corallum; both natural size.
 Fig. 6. *Cyathoseris irregularis*: corallum, natural size.

Fig. 7. *Cyathosotis magnifica*: a, corallum, two-thirds the natural size; b, calice, magnified 2 diameters.

Fig. 8. *Mycedium costatum*: a, part of calicular surface, natural size; b, calice, magnified 3 diameters.

XXXI.—On some new Genera and Species of Mollusca from the Seas of China and Japan. By ARTHUR ADAMS, F.L.S. &c.

ALREADY in the 'Annals' I have made known some conchiferous Mollusks which I believe to be peculiar types of form with which we have hitherto not been acquainted. Such, I conceive, is *Sarepta* among Nuculidæ, and *Cyrilla*, the affinities of which seem to be with *Limopsis*. In this communication I have briefly characterized two other forms which I am unable to refer to any genera already established,—one of which appears to be allied to *Bucardia*, and the other to *Montacuta*. The new species described below are also of great interest on account of their beauty or singularity of construction.

Genus CALLOCARDIA, A. Adams.

Testa cordata, tenuis, lævis, inflata; umbonibus parvis, subspirali-bus, approximatis. Cardio (in valva sinistra) dentibus duobus in-æqualibus, cum foveola angusta arcuata interposita, munitus; dente antico valde prominente, in medio angulatim flexo cum fossula antica et postica instructo, margine quadricuspidato; dente postico obliquo, arcuato, angusto, elongato, margine denticulis duobus vix elevatis instructo; dentibus lateralibus nullis. Pallii linea simplex; impres-siones musculares semilunares.

This genus is proposed for the reception of a beautiful shell, of which, unfortunately, I possess but a single valve, which in general appearance most nearly resembles a *Bucardia*. The surface of the valve is simple, as in *B. cor*, but it is not covered with an epidermis. The complicated nature of what I have termed the anterior cardinal tooth, which is furnished with four prominent cusps, and is angularly bent on itself in the middle, with a triangular pit on each side, together with the absence of lateral teeth, will distinguish *Callocardia* from the *Isocardia* of Lamarck. The genus *Anisocardia* of M. Munier-Chalmas, founded on a fossil shell from the Kimmeridge Clay of Havre, appears to bear some resemblance to my proposed genus; but in that form the surface of the valves is radiately grooved, the anterior muscular scar projects as in *Cucullæa*, and the disposi-tion of the hinge-teeth seems to be very different.

Callocardia guttata, A. Ad.

C. testa cordata, inflata, lævi, nitida, alba, maculis irregularibus aurantiacis conspersis pulcherrime guttata, superficie lineis incre-

menti concentricis ad marginibus validioribus instructa, latere postico vix flexuoso; lunula linea impressa circumcincta.
Alt. 8 lin., lat. 9 lin.

Hab. Off Quelpaart, 48 fathoms.

The valve from which the above description is taken is fresh and in fine condition. It is white, spotted irregularly with pale orange, and the surface is smooth and shining.

Genus *IACRA*, H. & A. Adams.

Shell ovate, thin, pellucid, closed at both sides; valves with the surface divaricately sculptured. Hinge with an oblique spoon-shaped cartilage-pit and a small anterior primary tooth in each valve. Lateral teeth two, stronger in right valve.

Iacra Japonica, A. Ad.

I. testa ovata, inaequilaterali, tenui, pellucida, nitida, convexa, latere antico latiore rotundato, postico angustiore et subproducto; valvis utrinque concentrice striatis, medio sulcis radiantibus obliquis ornatis, margine ventrali arcuato, integro; sinu palliali magno, lato, profundo.

Hab. Kino-O-Sima.

Smaller, more vitreous and pellucid, and with coarser sculpture, than *I. Seychellarum*, A. Ad.

Genus *THECODONTA*, A. Adams.

. Testa oblonga, aequivalvis, valde inaequilateralis, concentrice sulcata, latere antico brevior, postico longior. Cardo (in valva sinistra) dentibus duobus divaricatis, cum dente thecaeformi prominente interposito, munitus; dente antico crasso, arcuato, antice tuberculiformi; dente postico lamelliformi, tenui; dente laterali antico nullo, postico conspicuo elongato. Pallii linea simplex, valde impressa et radiatim sulcata; cicatrix musculari antica triangulari profunda, postica elongato-ovata.

In form and general character this genus seems to approach the fossil genus *Goodalliopsis* lately proposed by MM. Raincourt and Munier-Chalmas for a shell from the "Calcaire grossier" of Fercourt. In that genus, however, there is simply a triangular space between the cardinal teeth, and the teeth themselves are nearly similar; while in *Thecodonta* there is a cup-like fold projecting into the cavity of the shell, and the primary teeth are very dissimilar, the anterior being of a semilunar form, with a tubercular head at the theciform process, and the posterior being lamelliform and nearly parallel with the hinge-margin. There is only one lateral tooth, which is situated posteriorly. I have drawn up my description from left valves only, so that further information is required concerning the genus, especially

with regard to the position of the cartilage. I believe the place of the genus to be in *Lasæide*.

Thecodonta Sieboldi, A. Ad.

T. testa oblonga, obliqua, valde inæquilaterali, convexiuscula, subincrassata, alba, concentrice sulcata, sulcis subdistantibus; umbonibus parvis, latere antico brevior rotundato, postico longiore rotundato; margine ventrali simplici.

Alt. $1\frac{1}{2}$ lin., lat. $2\frac{1}{2}$ lin.

Hab. Gotto Islands; 71 fathoms.

Two left valves only were obtained, one of them in very good condition. The pallial line is thickened and impressed with radiating grooves, and the anterior muscular scar is very strongly marked.

Bucardia (Meiocardia) Cumingi, A. Ad.

B. testa transversa cordata, obliqua, cereo-alba, immaculata, concentrice plicata, plicis validis, regularibus, æqualibus, angulatis, super carinam terminantibus; latere antico brevissimo; umbonibus parvis; latere postico subacuminato, elongato, carinato; area postica tenuiter striata.

Hab. China Seas.

In form this species very much resembles *Isocardia Lamarckii*, Reeve; but the whorls are of a pure waxy white, the concentric plicæ are more conspicuous and angular, and the beaks are smaller, closer together, and not quite so much intorted.

Eucharis Recluzi, A. Ad.

E. testa subquadrato-elliptica, subcompressa, alba; umbonibus parvis, antrorsum vix inflexis; valvis hispidis, concentrice striato-rugosis, ab apice ad marginem posticum vix angulatis; latere postico dilatato, rotundato.

Lat. $6\frac{1}{2}$ lin., alt. 4 lin.

Hab. Yobuko.

A compressed species, subquadrately ovate, with the beaks small and somewhat angulate, and with the posterior side dilated and rounded.

Eucharis Gouldi, A. Ad.

E. testa trigonali-elliptica, convexa, alba; umbonibus antrorsum valde inflexis; valvis hispidis, concentrice rugoso-striatis, ab apice ad marginem posticum rotundatis; latere postico declivo, subangulato.

Lat. $5\frac{1}{2}$ lin., alt. $3\frac{1}{2}$ lin.

Hab. Inland Sea, Mososeki.

A somewhat trigonal species, with the beaks strongly inflexed, and the posterior area of the whorls rounded.

Eucharis Stimpsoni, A. Ad.

E. testa subquadrato-elliptica, compressa, alba; umbonibus parvis, acutis, antrorsum subinflexis; valvis hispidis, concentricè rugoso-striatis, ab apice ad marginem posticum valde angulatis; latere postico elongato, rotundato.

Lat. 6 lin., alt. 4 lin.

Hab. Inland Sea, Akasi.

A transversely ovate species, with the beaks sharp and inflexed, and with the posterior area of the whorls strongly and acutely angulate.

Leptoconchus rostratus, A. Ad.

L. testa ovato-pyriformi, tenui; spira obtusa, alba, longitudinaliter lamellosa; lamellis confertis, undulosis; apertura ovato-trigonalis, antice in rostrum acutum desinente; labio lævi; labro antice marginè sinuato; anfractu ultimo liris transversis instructo.

Hab. Kino-O-Sima; in Madreporas.

This species differs from *L. serratus*, Rüpp., in the lamellæ not being serrulate; and from *L. ellipticus*, Sow., in the fore part of the last whorl being produced into an acute beak, and in its pyriform shape.

Opalia exquisita, A. Ad.

O. testa pyramidalis, imperforata, acuminata; anfractibus 8, planatis, suturis canaliculatis; varicibus permultis, crassis, oblique punctato-striatis, ad angulum anfractuum aculeato-angulatis, interstitiis transversim liris; basi carina cincta; apertura circulari, varice antice subangulato, postice acuminato.

Hab. Gotto Islands; 71 fathoms.

The only species at all resembling this is *Scalaria porrecta*, Hinds, from the Straits of Malacca. In the species described above, the varices are produced into sharp points at the sutures in a very elegant manner, and are obliquely striato-punctate, with the spaces between them conspicuously lirate. It belongs to the group with a basal ridge, and which has received the name of *Opalia*.

Smaragdinella Sieboldi, A. Ad.

S. testa ovato-oblonga, vix involuta, aperta, tenui, glauca, pellucida, dorso longitudinaliter striata; labio lamella spirali vix dilatata instructo.

Hab. Takano-Sima; between tide-marks.

This species differs remarkably from the other species of the genus in the breadth of the spiral lamella which winds round the inner lip. In *S. viridis*, *S. glauca*, and *S. minor* the lamella is so broad that it forms, when it winds, a cup-shaped appendage. In *S. Sieboldi*, however, the lamella is so narrow that a spiral ridge only is visible.

XXXII.—*Diagnoses of new Forms of Mollusks collected at Cape St. Lucas by Mr. J. Xantus.* By PHILIP P. CARPENTER, B.A., Ph.D.

THE specimens here described belong to the Museum of the Smithsonian Institution, Washington, D. C. The first available duplicates will be found in the British Museum or in the Cumingian Collection. An account of the labours of Mr. Xantus will appear in the forthcoming volume of British Association Reports; and detailed notes on the species may be consulted in the American scientific periodicals for the current year.

Genus ASTHENOTHÆRUS*.

Testa extus "*Thraciæ*" similis: intus cardine edentulo, haud spatulato; cartilagine infra umbones sita.

1. *Asthenothærus villosior*.

A. testa inæquivalvi, inæquilaterali, umbonibus ad trientem longitudinis sitis; tenuissima, alba, (sub lente) omnino minutissime et creberrime pustulosa; rugis incrementi obtusissimis, irregularibus, maxime t. juniore, ornata; epidermide tenui, pallide olivacea induta; parte postica truncata, parum hiante; antica valde rotundata; marginibus dorsalibus et ventrali parum excurvatis; umbonibus angustissimis; regionibus lunulari et nymphali subcarinatis: intus, margine cardinali utriusque valvæ acuto; ligamento inconspicuo; cartilagine subspongiosa, satis elongata, postice deflecta; fovea haud indentata; cicatricibus adductorum parvis, subrotundatis; sinu pallii majore, ovali, ad dimidium interspatii porrecto. Long. .38, lat. .26, alt. .14 poll.†

2. *Solemya valvulus*.

S. testa minore, tenuissima, diaphana, vix testacea, cornea, pallidiore, lineis tenuibus, distantibus, fuscis, radiatim ornata; postice tenuiter radiatim striata; tumente, satis elongata, marginibus antico et postico regulariter excurvatis; umbonibus vix conspicuis; lineis anticis divaricantibus, extus parentibus, intus lacunam cartilagineam definientibus; cardine edentulo; ligamento postice elongato, antice curto, latiore, bifurcato; cicatricibus adductorum subrotundatis. Long. .85, lat. .25, alt. .14 poll.

3. *Tellina (Peronæoderma) ochracea*.

T. testa majore, parum inæquilaterali, tenui, satis planata; carneo-ochracea, intus intensiore; lævi, nitida, marginem versus striis incrementi; postice vix radiatim striatula; ventraliter antice valde excurvata, postice vix angulata; marginibus dorsalibus ob-

* *Ἀσθενής*, weak; *θαύρος*, hinge.

† The measures of length are taken from the anterior to the posterior margins.

tuse angulatis, umbonibus conspicuis; ligamento tenui et cartilagine subinternis; nymphis intortis: dent. card. utriusque valvæ ii., quarum i. bifidus; dent. lat. valvæ dextræ ii.; sinu pallii irregulariter ovali, per duos trientes interstitii porrecto; cicatr. adduct. subovatis, nitidissimis. Long. 1·9, lat. 1·4, alt. ·44 poll.

4. *Psammobia* (? *Amphichæna*) *regularis*.

P. testa minore, regulariter ovali, subæquilaterali; violacea, plus minusve radiata seu maculata; lævi, striolis incrementi ornata; epidermide tenui, flavido-olivacea induta, postice rugulosa; marginibus undique regulariter excurvatis; umbonibus vix projectis; ligamento conspicuo: intus dent. card. ii.-i., haud bifidis; cicatr. adduct. postica rotundata, antica ovali; sinu pallii elongato, haud incurvato, per duos trientes interstitii porrecto. Long. 1·05, lat. ·5, alt. ·26 poll.

5. *Callista pollicaris*.

C. testa magna, ventricosa, solidiore; epidermide tenuissima induta; sordide albida, umbonibus rufo-fuscis; (t. adolescente) punctulis crebris rufo-fuscis, et tæniis paucis circa nymphas ornata; lævi, striis incrementi exceptis; postice, et paululum antice, quasi pollice impresso notata; latiore, antice producta, sed haud angulata; postice unda depressa, supra nymphas radiante, inter costas duas obsoletas sinuante, margine subtruncato; marginibus ventrali regulariter excurvato, dorsali rectiore; lunula elongata, linea impressa definita, medio tumente, postice flaccida: intus candida; dent. card. normalibus; dente laterali valvæ dextræ postico, valvæ sinistræ antico, usque ad extremitatem lunulæ porrecto; cicatr. adduct. subrotundatis; sinu pallii magno, rotundato, usque ad medium interstitii porrecto. Long. 2·58, lat. 2·25, alt. 1·43 poll.

Figured by Mr. Reeve (Conch. f. 45) as "*Dione prora*, var." The above diagnosis proves it to be a distinct and (considering the general similarity of the thin, colourless, inflated group) a well-marked species.

6. *Callista* (? *pannosa*, var.) *puella*.

C. testa "*C. pannosa*" simili, sed multo minore, tenuiore, plerumque latiore; sinu pallii majore, eleganter incurvato; dent. card. multo tenuioribus, lat. ant. magis elongato; lamina cardinali umbones versus sinuata: colore maxime variante; plerumque ut in *C. pannosa* triangulariter maculata; plerumque ut in *Tapete virginea* notata; interdum albida, seu aurantia, seu fusca, haud maculata; rarius ut in *Tapete fuscolineata* penicillata; rarissime paucistrigata, seu maculis paucissimis. Long. ·66, lat. ·5, alt. ·32 poll.

Variat t. transversa. Variat quoque t. subtrigona, et formis intermediis.

Quoted by Mr. Reeve, under *Dione pannosa*, as "*D. puella*, Cpr."; but the name was only given in MS. in accordance with

Mr. Cuming's assertion that it was distinct. The colourless sub-trigonal shells were regarded by Mr. Reeve as a separate species; but he did not allude to them in his monograph.

7. *Levicardium apicinum*.

L. testa subtrigona, parva, tenuissima, nitidissima, subcompressa, epidermide tenui induta; radiis seu striis radiantibus nullis; striis concentricis satis regularibus, subobsoletis, t. jun. magis extantibus; umbonibus angustis, parum incurvatis; margine ventrali satis excurvato, antico parum producto, postico subtruncato, dorsalibus obtuse angulatis: colore valde variante; plerumque pallide viridi-cinereo, rufo-fusco seu angulatim tæniato seu maculato seu punctato; regione umbonali plerumque pallida, interdum rufo-fusca seu aurantiaca; parte postica haud intensiore: intus plerumque citrina, hepatico varie penicillata: dent. card. et lat. acutis, tenuibus; margine minutissime subobsoletim crenulato. Long. .55, lat. .5, alt. .3 poll.

Variat t. latiore. Variat quoque colore fere omnino hepatico, seu carneo, seu pallide aurantiaco, seu pallide cinereo, seu albedo: rarissime ut in *Tapete fuscolineata* ornata.

8. *Lucina lingualis*.

L. testa solida, linguiformi, valde prolongata; plerumque aurantiaco-carnea, intus intensiore; lirulis concentricis obtusis crebre ornata; marginibus undique excurvatis; lunula minima, altissime excavata; parte postica obscure biangulata, seu subrotundata; umbonibus anticis, incurvatis; ligamento subinterno, lamina valida; dent. card. et lat. normalibus, validis; cicatr. adduct. posticis subovalibus, anticis satis elongatis; linea pallii lata, rugosa; margine interno crenulato. Long. .88, lat. .92, alt. .4 poll.

Variat t. minus prolongata. Variat quoque t. pallide viridi, seu pallide carnea, seu alba.

9. ?*Crenella inflata*.

?*C. testa* valde inflata, minuta, albida, subrhomboideo-orbiculari; diagonaliter parum producta; marginibus subquadrangulatim rotundatis; umbonibus prominentibus, valde antice intortis; tota superficie ut in *C. decussata* sculpta, costulis crebris radiantibus æquidistantibus, hic et illic aliis intercalatis; lirulis concentricis decussantibus: intus margine dorsali brevissimo, arcuato, dentato; ligamento curtissimo, in fossa omnino interna, celata, lamina definiente, sito; lamina cardinali sub umbonibus intus porrecta, dentibus validis instructa; marginibus internis omnino crenatis; cicatr. adduct. subæqualibus, ventraliter sitis. Long. .1, lat. .12, alt. .09 poll.

Located provisionally in *Crenella* from its likeness to *C. decussata*, but with peculiarities of hinge and adductors which approach *Nuculina* on one side and *Cardilia* on another.

Genus BRYOPHILA*.

Animal Aviculidæum, viviparum : inter algas, etc., habitans.

Testa Pinnæformis, extus prismatica, intus subnacreæ : ligamentum solidum : umbones extantes, terminales, intus concavi.

10. *Bryophila setosa*.

B. testa parva, regulari ; cinerea, salmonæo seu chocolateo, intus subnacreo, exquisite tinota ; t. juniore planata, semiotundata, dorsaliter recta, æquilaterali, conspicue punctata : t. adolescente subdiaphana : t. adulta solidiore ; umbonibus rectis, terminalibus, intus alte excavatis ; marg. dorsali brevior, recto ; antico recto ; ventrali et postico late rotundatis ; extus epidermide subspongiosa vestita, radiis setarum subdistantibus, marginibus eleganter pectinatis : intus ligamento solido dorsaliter producto ; limbo pallii æqualiter prope marginem decurrente ; cicatr. adduct. submediana, inconspicua ; postice hiantæ ; antice propter byssum tenuem sinuata. Long. .13, lat. .2, alt. .1 poll.

Like a minute *Pinna*, or a transversæ *Margaritiphora* without ears, or an *Isochnomon* without pits. Differs from the other Aviculids in being viviparous, like some other minute bivalves.

11. ? *Atys casta*.

? *A.* testa elongata, tenui, subdiaphana, albidæ ; antrorsum paulum tumidiore ; spira celata, lacunata, (t. adultæ) haud umbilicata ; columella paulum intorta, effusa ; umbilico antico minimo ; labro postice producto, obtuse angulato ; tota superficie subtiliter spiralliter striatula. Long. .4, lat. .18 poll.

On the confines of the genus, related to *Cylichna*.

12. *Ischnochiton parallelus*.

I. testa ovata, subelevata (ad angulum 120°) ; rufo-fusca, olivaceo tincta ; valvis latis, marginibus parum rotundatis, interstitiis parvis ; valvis intermediis valde insculptis ; areis lateralibus seriebus granulorum a jugo radiantibus circiter vi. ; interdum irregularibus, granis rotundatis, separatim, extantibus ; areis centralibus clathris creberrimis, jugo parallelis, horridis, extantibus, interdum granulosis, ornatis ; valvis terminalibus seriebus granulorum, circ. xx., interdum bifurcantibus, ut in areis lateralibus, ornatis ; mucrone vix conspicuo ; limbo pallii angusto, pilulis furvicaceis creberrimis minutis conferto ; lobis valvarum bifidis, terminalibus fissuris circ. xi. a parte externa simplici disjunctis. Long. .7, lat. .48, alt. .16 poll.

Belongs to the group with minute setose scales.

13. *Ischnochiton* (? var.) *prasinatus*.

I. testa *I. parallelo* forma et indole simili, sed vivide viridi ; ar. diag. seriebus bullularum irregulariter ornatis ; ar. centr. clathris

* *Βρύον*, sea-moss ; *φίλος*, loving.

valde extantibus, acutis, jugo obtuso parallelis, utroque latere circ. xvi.; valv. term. seriebus bullularum circ. xviii.; mucrone submediano, inconspicuo; umbonibus haud prominentibus; tota superficie minutissime granulosa: intus valvarum lobis mediarum i.- term. circiter x.-fissis; sinu lato, planato; suturis planatis; limbo pallii angusto, minutissime squamulis furvicaceis creberrime instructo; interdum pilulis intercalatis. Long. .8, lat. .4 poll., div. 125°.

14. *Ischnochiton serratus*.

I. testa parva, cinerea, olivaceo hic et illic, præcipue ad suturas, punctata, interdum sanguineo maculata; ovali, subdepressa, suturis indistinctis; tota superficie minutissime granulata; ar. diag. valde distinctis, costis latissimis obtusis ii.-v. munitis, interstitiis nullis; marginibus posticis elegantior serratis; ar. centr. costis acutis, parallelis, utroque latere circ. xii.; jugo obtuso, haud umbonato; costis transversis, subradiantibus, fenestrantibus, interstitiis impressis: mucrone mediano, obtuso; valv. term. costis obtusis, ut in ar. diag., circ. xx.: intus valvarum mediarum lobis bifissis, terminalium circ. ix.-fissis; lobis suturalibus magnis: limbo pallii squamis majoribus, imbricatis, vix striatulis. Long. .34, lat. .2 poll., div. 115°.

Differs from *Elenensis* in the sculpture of the terminal valves.

[To be continued.]

XXXIII.—On the Menispermaceæ.

By JOHN MIERS, F.R.S., F.L.S. &c.

[Continued from p. 135.]

4. TINOSPORA.

THE first outline of this genus was given in my "Remarks on Menispermaceæ," in 1851 (Ann. Nat. Hist.). It comprises a group of Asian and African plants, all of climbing growth, the type of which is the *Cocculus cordifolius*, DC.: the stems have a lax, splitting, membranaceous bark, often furnished with verrucose tubercles. Colebrook and Roxburgh relate, concerning some of the species mentioned below, that when any portion of their stems becomes severed, it sends out, even from the greatest height, a sprout which lengthens downwards till it reaches the ground, when it takes root, by which the severed portion continues to maintain its flourishing growth; and they have seen radicant shoots of this description, 30 feet long, not thicker than a pack-thread. The plants have all roundish cordate leaves, more or less membranaceous, generally glabrous, upon slender petioles; their inflorescence is an elongated supra-axillary raceme, with small glabrous flowers; their somewhat globular fleshy drupes contain a spherical, smooth or tubercu-

lated, subosseous putamen, having a globular, hollow, internal condyle on the ventral face, with a small external aperture: round this condyle the meniscus-shaped seed, which fills the cell of the putamen, is moulded, and attached by the longitudinal line of the raphe. The embryo (as in all the rest of the *Heterocliniæ*) has a superior terete radicle and large divaricating foliaceous cotyledons, imbedded in distinct cells of a copious ruminated albumen.

TINOSFORA, nob.—*Flores* dioici. *Masc. Sepala* 6, biseriata, exteriora minora, obovata, glabra, submembranacea, margine eroso-crenulata; æstivatione imbricata. *Petala* 6, minuta, sepalis opposita, imo subunguiculata, apicem versus 3-loba, lobis lateralibus inflexis, stamina amplectentibus. *Stamina* 6, libera, divaricato-potentia, petalis opposita: *filamenta* longiuscula, apice clavato-incrassata; *antheræ* 2-lobæ, subextrorsæ, lobis oblongis, apice conniventibus, imo divaricatis, utrinque lateraliter semi-immersis, rima obliqua fere marginali longitudinaliter dehiscentibus. *Ovaria* rudimentaria nulla.—*Fœm. Sepala* ut in masc. *Petala* minuta, spatulato-oblonga, erecta. *Stamina* sterilia, 6, petalis opposita, breviora et cum illis imo gynæcii affixa: *antheris* effœctis. *Ovaria* 3, gibbosoblonga, libera, supra gynæcium cylindricum imposita, erecta, 1-locularia; *ovulo* unico anatropo supra medium loculi ex angulo interno funiculo brevi appenso. *Stylus* brevis, crassus. *Stigma* subliguliformi-peltatum, subcavum, margine sinuatum, aut profunde 3-laciniatum, laciniis inæqualibus rotundatis. *Drupæ* 3, vel abortu pauciores, globosæ, gibbosulæ, carnosæ, breviter stipitatæ, stigmate persistente subexcentrico apiculatæ: *putamen* osseo-pergamineum, compresso-subglobosum, dorso convexius, hic sæpe tuberculatum, sutura peripherica, sub-2-valvare, ventre subplanum, hinc intus *condylo* magno cavo globoso usque ad medium loculi protenso, meatu externo lineari perforato instructum. *Semen* loculo conforme, meniscoideum, ad faciem ventralem valde cavum: *integumenta* tenuissima, intra fissuras albuminis plicata, *raphe* ventrali longitudinali signata: *embryo* intra *albumen* 2-laminare inclusus, lamina dorsali tenui, simplici, ventrali crassiore, in rugas plurimas transversas profunde ruminata; *cotyledonibus* tenuissime foliaceis, ovatis, 3-nerviis, valde divaricatis, in locellis sejunctis utrinque absconditis, *radicula* supera tereti multo longioribus.

Frutices alte scandentes, Asiæ, Australasiæ, et Africæ intertropicæ: folia petiolata, cordata, submembranacea, 3-5-nervia: racemi simplices, extra-axillares; ramis plurimis, imo bracteatis, 1-4-floris; flores aggregati, flavi.

1. *Tinospora cordifolia*, nob., Ann. Nat. Hist. ser. 2. vii. 38; Hook. & Th. Fl. Ind. i. 184;—*Cocculus cordifolius*, DC. Syst. i. 518, Prodr. i. 97; *Rheede, Hort. Mal.* vii. 39, tab. 21; *W. & A. Fl. Ind.* i. 12; *Wight, Icon.* ii. tab. 485, 486; *Colebr. Linn. Trans.* xiii. 62;—*Cocculus convolvulaceus*, DC. Syst. i. 518, Prodr. i. 97;—*Cocculus verrucosus*, Wall. Cat. (partim);—*Menispermum cordifolium*, Willd. iv. 826; *Roxb. Fl. Ind.* iii. 811;—ramulis teretibus, striatis, cortice laxo, nitente, tuberculato; foliis suborbicularibus, late cordatis, acutis aut repente tenuiter acuminatis, glaberrimis, submembranaceis, 7-nerviis, subtus subglaucis; petiolo limbo brevior aut subæquilongo; racemis in axillis solitariis, simplicibus, glabris, ♂ folio brevioribus, ♀ folio longioribus; floribus ♂ fasciculatis, ♀ solitariis; drupis rubris, cerasiformibus, siccitate pisi magnitudine.—In India orientali, v. s. in herb. Soc. Linn., Mungger (Wall. Cat. 4955), Ava (Wall. Cat. 4966 B, sub *Coc. verrucosus*); in herb. Mus. Brit. et Hook. (Wight, 44), &c.

This species appears to have an extensive range all over the peninsula of India, extending even to Ceylon: the length of the leaves is 2–4 inches, their breadth is the same, or more; the petiole is $1\frac{1}{2}$ – $2\frac{1}{2}$ inches long; on their under surface, at the junction of the nerves (which, however, are not connected by a membrane), an oblong brown spot is usually seen between them; the ♂ raceme is $2\frac{1}{2}$ inches, the ♀ 5 inches long. *C. cordifolius*, DC., seems to be the ♂, and *C. convolvulaceus*, DC., the ♀ plant. In the male flower, the petals are 3-lobed, and their inflected lobes embrace the filaments; in the female, the petals are cuneately oblong, with entire margins, which are not inflected: the inner sepals scarcely exceed a line in length.

2. *Tinospora palminervis*, nob.;—*Cocculus verrucosus*, Wall. (partim);—cortice laxo, verrucoso; ramulis junioribus subangulatis, glabris, lenticellis parvis signatis; foliis remotis, deltoideo-oblongis, acuminatis, marginibus integris vel repando-sinuatis, imo cordatis, sinu subangulato, 5–7-nerviis, membranaceis, glaberrimis, supra pallidis, subtus glaucis, hinc nervis ad concursum basalem membranula ligatis; petiolo limbo fere 3-plo brevior; racemis ♂ geminis vel solitariis, supra-axillaribus, gracilibus, folio vix longioribus; floribus 2–3, in ramis brevibus pedicellatis.—In Birma, v. s. in herb. Soc. Linn., Fluv. Irawaddi (Wall. Cat. 4966).

In its general features this species approaches the preceding, both having cordate, glabrous, pale, membranaceous leaves upon very slender petioles, which seldom exceed half the length of the blade; they have a similar verrucose bark; but the leaves are deltoidly oblong, acute, with sinuose margins, and the basal

nerves beneath are united by web-shaped membrane, leaving hollow spaces beneath them, while the corresponding portion of the upper surface shows a large brown spot, as in *T. cordifolia*. The leaves are $2\frac{1}{2}$ –4 inches long, with a broad angular sinus $\frac{1}{2}$ inch deep; they are 2 – $3\frac{1}{2}$ inches broad, on a very slender petiole 1 – $1\frac{1}{2}$ inch long. The male slender racemes are $8\frac{1}{2}$ –8 inches long, with alternate branches $\frac{1}{2}$ – $\frac{3}{4}$ inch long, bracteolated at base, and bearing two or three flowers on very short pedicels.

3. *Tinospora Malabarica*, nob. l. c.; Hook. & Th. l. c. 183;—*Cocculus Malabaricus*, DC. Syst. i. 518, Prodr. i. 97; *Rheede, Hort. Mal.* vii. t. 19, 20;—*Menispermum Malabaricum*, Lam. Dict. iv. 96; Willd. Syst. iv. 826;—ramulis tortuosis, teretibus, verruculosis, pilis albidis adspersis; foliis sparsis, obovatis, acutis, apice acuminatis, imo profunde cordatis, sinu rotundato, 7-nerviis, reticulatis, pallide membranaceis, supra pilosulis, subtus pubescentibus; petiolo tereti, basi incrassato, piloso, limbo fere dimidio brevior; racemis supra-axillaribus, tomentosis, ♂ folii longitudine, ♀ simplicibus, petiolo brevioribus; floribus viridibus; drupis cerasiformibus, pallide rubris.—In Malabar, v. s. in herb. Soc. Linn. (Wall. Cat. 4969).

In this distinct species the leaves are about $5\frac{1}{2}$ inches long from the bottom of the basal lobes, or $4\frac{1}{2}$ inches from the insertion of the petiole to the apex, 4 inches broad, on a petiole 8 inches long; the fructiferous raceme is 2 inches long, the alternate pedicels about 3 lines long; the drupes, of a bright-red colour, are stipitated; the putamen, about 3 lines long, marked externally by many sharp-pointed tubercles arranged in longitudinal interrupted lines.

Var. *scabridula*;—foliis remotis, longe petiolatis, suborbicularibus, gradatim angustioribus, apice repente cuspidato-atenuatis, imo profunde ac late cordatis, pallidis, supra ruguloso-scabris, subtus tomento sparso pubescentibus, nervis prominentibus, et ad basin membranula ligatis; petiolo limbo subæquilongo, imo incrassato et torto, puberulo.—Khasia et Chittagong, v. s. in herb. Hook.

Its leaves are $5\frac{1}{2}$ inches long (or $4\frac{3}{4}$ from the basal sinus to the apex), $4\frac{1}{2}$ inches broad; petiole $4\frac{1}{2}$ – $4\frac{3}{4}$ inches long.

4. *Tinospora tomentosa*, nob. l. c.; Hook. & Th. l. c. 182;—*Cocculus tomentosus*, Coleb. Linn. Trans. xiii. 59;—*Menispermum tomentosum*, Roxb. Fl. Ind. iii. 813;—ramulis striatis, cortice rimoso, piloso, tuberculis minutis exasperatis; foliis orbiculato-ovatis, basi in sinum latissimum cordatis, apice rotundato-obtusis, retusis, margine sinuatis, 7-nerviis, valde membranaceis,

pallidis, supra pubescentibus, subtus cano-tomentosis; petiolo limbo paulo brevior; racemis supra-axillaribus, simplicibus; floribus paucis, aggregatis, sepalis expansis, petalis subintegris, drupis aurantiacis.—In Bengalia et Ava, v. s. sine flore aut fructu, in herb. Soc. Linn. (Wall. Cat. 4956 A, B).

Colebrook states that its leaves are from 3 to 6 inches long, and about the same breadth, with a petiole of nearly equal length. In Wallich's specimen they are 4 inches long, $3\frac{1}{2}$ inches broad, sinuated near the summit; the apex is obtusely narrowed and deeply emarginated, the petiole being 3 inches long. In Roxburgh's specimen, the sinuated margins are almost obsolete, while the summit has a deep emargination, with a mucronate point: it is 4 inches long, $3\frac{1}{2}$ inches broad, the petiole, thickened at its base, being $2\frac{1}{4}$ inches long. The drupes are said to be orange-red, the size of a large pea, enclosing a tuberculated putamen.

5. *Tinospora glauca*, nob.;—*Cocculus glaucus*, DC. *Syst.* i. 521, *Prodr.* i. 97;—*Menispermum glaucum*, Lam. *Dict.* iv. 100; *Rumph. Amb.* v. 40, t. 25. f. 1;—ramulis teneribus, teretibus, pilosis; foliis vagis, orbiculari-cordatis, acuminatis, imo macula purpurascente notatis, et hinc 5-nerviis, supra flavescens, subtus glaucis et pubescentibus; petiolo rigido, imo recurvo, folio fere dimidio brevior; racemis paniculatis, petiolo brevioribus, drupis purpureo-nigricantibus, parvis.—In Amboyna.

This is described as a climber, with distant leaves, 3–4 inches long, and of equal breadth. Lamarck considered this species to be distinguished from the preceding ones by its much shorter racemes and its much smaller drupes of a blackish hue, scarcely as large as a peppercorn: its putamen is somewhat compressed and tuberculated.

6. *Tinospora crispa*, nob., Hook. & Th. l. c. 183;—*Cocculus crispus*, DC. *Syst.* i. 521, *Prodr.* i. 97; *Colebr.* l. c. p. 60, tab. 5. f. 3;—*Menispermum crispum*, Linn.;—*Menispermum tuberculatum*, Lam. *Dict.* iv. 96;—*Menispermum verrucosum*, Roxb. *Fl. Ind.* iii. 808;—ramis glaberrimis, cortice nitido, laxo, brunnescente, striato-corrugato, remotiuscule verrucosis; foliis interdum crebriter approximatis, longissime petiolatis, suborbicularibus, imo late 2-sinuato-cordatis, apice subito ac breviter acutis, valde membranaceis, 5–7-nerviis, sub lente rugoso-punctulatis, utrinque glaberrimis, glauco-pallidis, nervis subtenuibus paulo prominulis et rufulis; petiolo limbo multo longiore, compresso, sulcato-striato, imo incrassato

et tortuoso, flavide pruinoso; racemo fructifero petiolo 8-plo brevior, pedicellis alternis, patentibus; drupis majoribus, subglobosis, uviformibus, flavescenti-puberulis vel pruinosis. —In India Orientali, v. s. in herb. Hook. Assam (Griffiths) et Sandoway (Capt. Margrave).

This species is said by different botanists to be common in Sumatra, the Molucca Islands, and Sylhet, and ought therefore to occur frequently in collections; but it is strange that this is the first specimen I have seen in any herbarium that corresponds with the written descriptions of it, among which Colebrook's is fullest in details; but he says the leaves are remote, which seems at variance with the specimen in question. Whether this plant truly represents the *Cocculus crispus*, DC., time must show. The branchlets, 4 lines in diam., have a thin lax bark, of peculiar appearance: it is longitudinally corrugated or crisped, with numerous raised cup-shaped cicatrices, that leave no impression upon the wood beneath—a character that distinguishes it from most other species: these cicatrices are placed promiscuously all round the stem of the branch, at intervals of $\frac{1}{4}$ – $\frac{1}{2}$ inch apart, presenting a very different appearance from the verrucosities of the bark of other species, which are caused by the swelling of the lenticels, and usually appear as minute bead-like prominences round a punctiform centre. In the specimen above cited six or seven petioles are entangled together by their tortuous bases, just as they have fallen off in a heap from the stem; and on a new branchlet a number of young leaves are to be seen crowded together in a similar manner. The leaves are $4\frac{1}{2}$ inches long, the depth of the basal attenuation and corresponding sinus on each side being 3 lines; they are 4 inches broad, the petiole being of the unusual length of $5\frac{1}{4}$ inches and $\frac{3}{4}$ line in diam., which is three times as long as, and stouter in proportion to the size of the blade than in *T. palmi-nervis*, which plant I was at first inclined to refer to *T. crispa*: the axils of the secondary nervures, and the five principal nerves at their confluence with the petiole, are extended by a web-shaped membrane. The fructiferous raceme is $2\frac{1}{4}$ inches long, the pedicels rigid, much divaricated, $\frac{3}{4}$ inch long; the drupes 8 lines long, 6 lines in diam. when dry; the putamen, $6\frac{1}{2}$ lines long, has a scrobiculated surface covered with a white pruinose down. Colebrook (*l. c.*) gives a tolerably correct analysis of the fruit and seed.

Var. *nitidiuscula*;—foliis oblongo-ovatis, profunde et late cordatis, e medio sensim angustioribus, apice subito acuminatis, utrinque glaberrimis, subtus præsertim nitentibus, hinc nervis 5, ad concursum membranula conspicua connexis; petiolo

limbo fere æquilongo.—Khasia, in *herb. Hook.* (*Hook. & Th.*), sine flore.

This is probably a distinct species; but I have placed it here till better evidence is obtained: it differs from all others in the peculiar texture of the leaves and the remarkably shining appearance of their under surface; its branchlets are 1 line in diam., with internodes of $3\frac{1}{2}$ inches, the leaves are $4\frac{1}{4}$ – $4\frac{1}{2}$ inches from the bottom of the rounded basal sinus to the apex, or $4\frac{1}{2}$ – $5\frac{1}{4}$ inches from the bottom of the basal lobes, and $3\frac{1}{2}$ – $3\frac{3}{4}$ inches broad, on a petiole 4 inches long.

7. *Tinospora uliginosa*, nob.;—ramulis teretibus, glabris, lenticellis parvis 4-lobulatis signatis; foliis remotis, oblongis, cordatis, marginibus subpandurato-sinuatis, apice acuminatis, subcoriaceis, glaberrimis, 5-nerviis, subtus pallidis, nervis venisque valde reticulatis prominentibus; petiolo tenui, imo incrassato et tortuoso, limbo subæquilongo vel dimidio brevior; racemis axillaribus, glaberrimis, folio longioribus; rachi tenui, simpliciter pedicellato, pedicellis 1-floris, floribus viridibus, pro mole majoribus.—In Java et Borneo, *v. s. in herb. Hook.*; ♂ Java (Zollinger, 568); ♀ Barmassing, Borneo (Motley, 716).

The authors of the 'Flora Indica,' though evidently with some doubt, have considered this plant as identical with *T. crispa*: it agrees with it far less in general habit than with many others; but it differs in its leaves, which are smaller, more oblong, less cordate, more coriaceous and rigid in texture, and they have a more elongated raceme. The leaves are $2\frac{1}{4}$ – $3\frac{1}{4}$ inches long, $1\frac{1}{2}$ –2 inches broad; the petiole 1–2 inches long. The ♂ raceme is 4–8 inches long, its flowers larger, its inner sepals being 2 lines long, which is twice the size of those in the typical species. In the Borneo specimen, which I have considered identical, the leaves are smaller, the petiole and raceme shorter: it is described as a climbing plant, growing in marshy places; the ovaries are supported by a long cylindrical gynæcium.

8. *Tinospora reticulata*, nob.;—scandens; ramulis teneribus, teretibus, glabris, remote lenticellatis; foliis ovatis aut oblongis, basi truncatis et 2-sinuatis, vix cordatis, circa petiolum attenuatis, apice repente acuminatis, et hinc canaliculato-recurvis, imo 5-nerviis, reticulatis, vix membranaceis, glaberrimis, utrinque pallidis et subnitidis; racemo axillari, petiolo 4-plo longiore, basi foliifero.—In ins. Philippinis, *v. s. in herb. variis* (Cuming. 1286).

This plant has the peculiarity, seen in all the following species from Africa and Australia, of bearing rudimentary, and often

deciduous, petiolated leaflets in the lower axils of the racemes, which in *T. Bakis* are largely developed. The branchlets are slender, quite glabrous, dull, and striated with a few raised lenticles, the internodes being of 2 inches; the leaves are 3-4 inches long, 2-2½ inches broad, with a petiole 1-1½ inch long; the racemes are 4-6 inches long, the three lowermost flowerless axils 1 inch apart, bearing alternate leaflets similar in form, 1 inch long, ¾ inch broad, on a petiole ⅝ inch long; the pedicels are 2 lines long, 2-3 lines apart, bracteate at base, all very glabrous; the flowers are somewhat large, the inner sepals being fully 1½ line long.

9. *Tinospora Bakis*, nob.;—*Cocculus Bakis*, *A. Rich. in Guill. et Perott. Fl. Seneg.* i. 12, tab. 4;—ramulis teretibus, subsu-berosis, glabris, striatis, cortice pallido rimoso verruculoso tectis; foliis oblongis, profunde cordatis, lobis basalibus rotundatis, apice longe acuminatis et mucronatis, canaliculato-recurvis, et hinc subconduplicatis, submembranaceis, glaberrimis, 5-7-nerviis, nervis supra immersis, subtus prominulis; pedunculis axillaribus, 1-3-floris, vel in ramulis novellis apice aphyllis racemum terminalem glaberrimum efformantibus; racemis ♀ folio brevioribus.—In Africa tropica septentrionali, *v. s. in herb. DC.*, Senegambia ♂ (Perottet); *in herb. Delessert* (Heudelot); *in herb. Hook.*, Nubia, ad Fazokel, ♂ (Kotschky, 421); Cordofan, ♀ (Kotschky, 244).

I have considered the latter specimens as specifically identical with the former, which is the typical plant of Perottet's collection, the only difference being that in the former the leaves have a broad sinus at the base, while in the latter the basal lobes are separated by a more acute sinus. The leaves are 2-3 inches long, 2-2½ inches broad, on a petiole 1-1½ inch long; the axillary raceme is almost filiform, 4-6 inches long, often, but not always, leaf-bearing at its base, as in the preceding species, the leaves there being 1¼-1½ inch long, 1¼-1½ inch broad, on a petiole 4 lines long; the alternate pedicels, bracteate at base, are 1 line long; the flower expanded, 3 lines in diam.

10. *Tinospora tenera*, nob.;—glaberrima, ramulis tenerrimis, teretibus, striatis, verruculoso-tuberculatis; foliis rotundato-ovatis, imo cordatis, sinu acuto, lobis basalibus rotundatis, e medio gradatim acutioribus, apice recurvis et breviter attenuatis, vix membranaceis, 5-nerviis, nervis teneribus, supra rugoso-punctatis, punctis nigris, subtus pallidioribus, nervis venisque reticulatis paulo prominentibus; petiolo sublongo, tenerrimo, subito deflexo; racemis solitariis, supra-axillaribus, glaberrimis, valde elongatis; rachi filiformi; pedicellis brevis-

simis, 1-floris.—In Africa orientali, v. s. in herb. Hook., Lower Shire Valley, Zambesi (Dr. Kirk).

A climbing plant, collected during Dr. Livingstone's explorations up the River Zambesi, having slender branches $\frac{3}{4}$ –1 line in diam., with internodes of $1\frac{1}{2}$ – $2\frac{1}{2}$ inches; leaves 2– $2\frac{1}{2}$ inches from the end of the basal lobes to the apex, or $1\frac{1}{2}$ – $2\frac{3}{8}$ inches long from the basal sinus, $1\frac{1}{4}$ – $2\frac{1}{8}$ inches broad, with a petiole $1\frac{1}{8}$ inch long; the punctate raised dots on the upper surface of the leaves are not at all scabrid; the raceme is 5–7 inches long.

11. *Tinospora Smilacina*, Bth. Proc. Linn. Soc. v. Suppl. 52;—glabra; ramulis subcoriaceis; foliis deltoideo-ovatis, profunde cordatis, sinu subangulato, lobis basalibus intus rectis, extus rotundatis, apice acutis et acuminatis, imo 5-nerviis, utrinque glabris et pallidis, nervis supra immersis, subtus prominulis, reticulatis; petiolo tenui limbo dimidio brevior; racemis axillaribus, simplicibus, petiolo paulo longioribus, imo foliolis minimis petiolatis donatis; floribus parvis viridulis.—In Australia centrali, v. s. in herb. Hook., Plains of Promise (Dr. Moore).

This is a slender climbing plant, with internodes of 1– $1\frac{1}{2}$ inch; its leaves, from the basal lobes to the apex, 24–33 lines long, or from the basal sinus 19–25 lines long, 26 lines broad, with a petiole 10–12 lines long. The ♂ raceme is 18 lines long, pedicels 1 line long, with petiolated bracts at base 2 lines long; the three inner sepals are ovate, 1 line long, the membranaceous obovate petals $\frac{1}{2}$ line long; its drupes are ovate, 8 lines long.

[To be continued.]

XXXIV.—*New Observations on the Existence of Man in Central France at a period when that Country was inhabited by the Reindeer and other Animals which are now extinct there.* By MM. LARTET and CHRISTY, in a Letter from M. LARTET to Prof. Milne-Edwards; communicated by him to the Academy of Sciences in Paris*.

IN support of the remarks made by you, at one of the recent meetings of the Academy, with regard to the figures of animals engraved on bones found in the cavern of Bruniquel, I have, in my own name and that of Mr. H. Christy, F.G.S., to inform you of several other facts of the same nature. We shall, however, limit ourselves for the present to mentioning the discoveries made by us, during the last five months of the year 1863, in that part of the old province of Périgord which now forms the arron-

* Translated by W. S. Dallas, F.L.S., from the 'Comptes Rendus,' February 29, 1864.

dissement of Sarlat. One of the grottoes of this region (that of Les Eyzies, in the commune of Tayac) has presented us, in a breccia covering the soil in the form of a continuous floor, with an aggregation of broken bones, ashes, fragments of charcoal, chips and flakes of flint worked in different modes, but always in definite and frequently repeated forms, associated with other utensils and weapons manufactured of the bones or horns of the Reindeer. The whole of these things must have been fixed and consolidated into a breccia in the original state of the deposit, and before any re-arrangement, as series of several vertebræ of the Reindeer, and some assemblages of articulations consisting of several pieces, occur precisely in their anatomical connexion; the long bones with medullary cavities only have been detached, and split or broken in a uniform manner—that is to say, evidently with the object of extracting the marrow from them. What we now advance may, moreover, be proved by any competent observer, as we have taken care to have this breccia extracted in large slabs; and, after depositing the finest specimens in the museum at Périgueux and in the collection of the Jardin des Plantes at Paris, we have sent to various museums in France and elsewhere blocks of sufficient size to allow the verification of the observations of which we here give the details.

This grotto of Les Eyzies, the mouth of which is situated thirty-five metres above the level of the nearest watercourse, the Beune, also contained many pebbles and fragments of rocks foreign to the basin of that little river, and which must have been introduced there by man. Some of these rather large pebbles, chiefly those of granite, are flattened on one side, rounded in their outline, and hollowed above by a cavity of greater or less depth, which bears traces of repeated friction.

In the grotto there were also numerous fragments of a schistose rock, of considerable hardness; and upon two slabs of this rock we have been able to discern partial representations of animal forms engraved in profile. These are, we presume, the first examples observed of engraving on stone, at this ancient phase of the human period, when the Reindeer still inhabited what are now the temperate regions of Europe*.

* Figures of animals, dating from this same epoch, were reproduced by one of us in 1861 (*Ann. Sc. Nat. sér. 4, Zool. tom. xv. pl. 13*); but one of these figures, readily recognizable as the head of a bear, is engraved upon the horn of a deer. The other also is engraved upon the bone of a Ruminant: it represents two complete animals, which have been thought to resemble the Reindeer. The latter specimen, which was obtained from the grotto of Chaffaut, in the commune of Savigné (Vienne), has been deposited in the Cluny Museum by M. Mérimay, in the name of M. Joli Le Terme, architect at Saumur. It is accompanied by worked flints and reindeer-bones from the same locality.

Upon one of these slabs, which has reached us in an incomplete state in consequence of an ancient fracture, we can distinguish the fore quarters of a probably herbivorous quadruped, of which the head must have been armed with horns, as far as can be judged by the uncertain lines, which enter but slightly into this rather hard rock. In the other slab we recognize more readily a head, with the nostrils clearly marked, and the mouth half open, but which has its profile-lines interrupted in the frontal region by a sort of obliteration resulting from an apparently artificial friction posterior to the preparation of the engraving. A little in front upon the same slab there is the design of a large antler, which, if it really belongs to this head, would lead us, as you were the first to suggest, to refer it to the Elk.

Besides the ossiferous deposits of the interior of caves, which are so numerous in the Périgord district, we may also investigate there the analogous accumulations of organic débris which rest against the great escarpments of the cretaceous rocks in that region, and are sometimes sheltered merely by more or less overhanging projections of the rock. These exterior deposits likewise abound in worked flints and in fractured bones of animals (horse, ox, ibex, chamois, reindeer, birds, fishes, &c.), which have evidently served as food for the indigenous populations at this ancient period of the age of stone. The remains of the common stag are very rare, as are also those of the wild boar and the hare. We have found some isolated teeth of the gigantic Irish deer (*Megaceros hibernicus*), and some detached plates of the molars of the Mammoth (*E. primigenius*), exactly as we observed them in the hearth of the funeral feasts of the ancient burying-place of Aurignac, without being able to explain for what useful purpose these dentary laminæ were preserved thus isolated*.

It is likewise in these exterior stations that we have collected the finest worked flints, particularly at that of Laugerie-Haute, where there seems to have been established a manufactory of the fine lance-heads worked with little chips upon the two faces, and with the margins slightly undulated. But we have probably found only the refuse of this manufactory, as very few specimens were entire amongst more than a hundred fragments which we obtained.

* This reminds us that, in the grotto of Les Eyzies, we have found a part of the cortical portion of an elephant's tusk bearing traces of human work. We also collected there a metacarpal bone of the small digit of a young *Felis* of great size (*Felis spelæa*?), on which are seen small cuts and numerous scratches, produced by a cutting-tool, exactly like those which are observed upon the bones of reindeer or horses which have been eaten by men.

At Laugerie-Basse, about a third of a mile lower down, but still upon the banks of the Vézère, there was probably another factory of weapons and tools in reindeer-horns, if we may judge from the enormous quantity of the remains of horns of this animal accumulated there, nearly all of which bear traces of sawing, by means of which the pieces intended to be worked up were detached. It is there especially that we have procured, besides arrows and barbed harpoons (such as occur in nearly all the stations of this age), that great variety of utensils, some of which are adorned with elegant sculptures, the workmanship of which is truly astonishing when we consider the means of execution which could be possessed by these people, who were ignorant of the use of metals. Amongst them are some needles of reindeer's horn, finely pointed at one extremity, and pierced at the other with a hole or eye for the reception of a thread of some kind.

There are also some tools furnished at their extremity with obtuse notches, which would lead one to suspect that they were employed in the manufacture of nets. Teeth of various animals (wolf, ox), perforated at the root, must have served as ornaments, as also some other objects fashioned like ear-drops, sometimes of the ivory-like part of the ear-bones of the horse and ox.

Another object, previously found by one of us at the burying-place of Aurignac, and upon which he thought it as well to say nothing (distrusting the value of an observation still unique), has occurred both at Laugerie and in the grotto of *Les Eyzies*. It is a first phalanx, which is hollow in certain ruminants, and which is here pierced artificially beneath, a little in front of its metatarsal or metacarpal articulation. By placing the lower lip in the posterior articular cavity, and blowing into the hole, a sharp sound, like that given by a key-pipe of moderate size, is produced. This was, no doubt, a call-whistle, in common use amongst these tribes of hunters; for we have now four specimens, of which three are made of phalanges of the reindeer, and the fourth of a phalanx of the chamois.

At Laugerie-Basse, also, thanks to the intelligent supervision and minute precautions of M. A. Laganne, who had the management of our diggings, we have obtained portions of reindeer-horn which, notwithstanding the alteration that they have undergone by age, still retain very distinct representations of animal forms. Some of them are simply engraved in outline upon the palmature or terminal expansion of the frontal antlers of the reindeer; others are regularly sculptured, either in bas-relief or even in complete relief, upon portions of the horn of the same animal prepared for this purpose.

One of these palmations, of which an ancient fracture has caused the loss of a portion of the design, still presents us with

the exact outline, traced with a firm hand, of the hind-quarters of a large herbivorous animal. The slenderness of the tail, the small flexure of the knees, and especially the very forward position of the indication of the male sex, show that this is not a horse: we rather recognise in it a bovine form; and the sudden elevation of the dorsal line towards the withers would appear to lead us to the Aurochs. Unfortunately, the interruption of the design by the fracture of the specimen comes exactly at the point where the tufted mane, characteristic of the subgenus *Bison*, ought to commence.

In a second and more widely dilated palm, we find another evidently bovine form, judging from the knees and the small hoofs placed behind the cloven hoof. In this, the thicker tail, the more horizontal direction of the line of the back, and the presence of a smooth pendant dewlap between the anterior legs indicate a tendency towards the true ox (*Bos primigenius* ?); but a fracture has caused the loss of the region of the head to which the horns were attached; and the artist, in order to utilize the divisions of the palmature, has given the animal a distorted attitude, which injures the general effect of the design.

A third palmature, in which the engraved design has been preserved nearly entire, exhibits an animal of which the head is armed with two horns rising at first vertically and then bending back towards their point; behind these horns we see a less distinct indication of the ears, and beneath the chin that of a tuft of hair or beard—peculiarities which would lead us to regard it as a female Ibex, if they were not contradicted by the peculiar form of the face and by a swelling behind the ears. In this figure, moreover, the designer, with no apparent necessity for so doing, has bent up the hinder limbs beneath the belly of the animal in such a manner that the distinctly cloven hoofs touch the abdomen.

Among the sculptured pieces obtained from this same locality of Laugerie-Basse, we shall mention a rounded staff made of the stem of a reindeer-horn, and terminated at one end in a lance-point with a recurrent lateral hook. Was this a tool, a weapon, or a sign of authority? We cannot tell. Immediately above the hook, we see sculptured in half-relief upon three of its faces a horse's head, with the ears laid down, and rather long for the species, although not sufficiently so to lead one to attribute this figure to the ass. In front, and still upon the continuity of the staff, there is a second head, with a slender muzzle, and armed with branching horns. The basilar antlers are sculptured in front upon the horizontal prolongation of the staff, whilst the main stem and the palmature are thrown backwards: the slender form of the head, which shows no indication of a muffle, the

apparent dilatation of one of the basilar antlers, and the whole physiognomy of this figure would lead us to refer it rather to the reindeer than to the common stag. In front of the muzzle of this head there is another figure, simply engraved in outline, which may be easily taken for a form of fish.

There is another excellent specimen in which the art-sentiment is especially revealed by the clever manner in which the artist has been led to bend animal forms, without too much violence, to suit the necessities of a useful purpose. It is a poignard or short sword of reindeer-horn, of which the entire handle is formed by the body of an animal: the hind legs are laid in the direction of the blade; the fore legs are bent back, without effort, beneath the belly; the head, which has its muzzle elevated, forms with the back and the crupper a concavity designed to facilitate the grasping of this weapon by a hand which must have been much smaller than those of our European races. The head is armed with branched horns, which are closely applied to the sides of the neck without in any way hindering prehension; but the basilar antlers have necessarily been suppressed. The ear is smaller than that of the stag, and is also, in its position, more in agreement with that of the reindeer; lastly, the artist has left beneath the neck a projection, in the form of a thin plate notched at its edge, which sufficiently resembles the tuft of hair often found at this point in the male Reindeer. It is to be regretted that this specimen has reached us in the condition of a mere sketch, as may be judged from the unfinished workmanship of the blade, and from certain details of the sculpture being scarcely indicated.

If it were necessary to add fresh evidence to that already furnished in proof of the contemporaneity of man and the reindeer in those regions which have become the southern and central France of the present day, we might mention numerous horns of that animal at the base of which may be distinguished cuts made in detaching the skin from them. We should also call attention to other transverse cuts which are frequently observed at the bottom of the cannon-bones of our reindeer of the caves, produced during the cutting of the tendons, performed (as among the Esquimaux of the present day) with the intention of splitting them up and dividing them into threads which serve for sewing together the skins of animals and also for the formation of cords of great strength.

Lastly, we can also show a lumbar vertebra of the Reindeer pierced from side to side by a flint weapon, which has remained fixed in the bone, where it is further retained by a calcareous incrustation.

As an archæological fact characteristic of the period of the

Reindeer in France, we shall only mention that, out of seventeen stations where we have ascertained the presence of that animal in a state of subjection to the action of man, there is not one in which we have observed traces of polishing upon the stone weapons; nevertheless the worked flints have been collected by thousands, in every variety of type, and passing through all degrees of perfection of workmanship, from the roughly sketched form of the *haches* from the diluvium of Abbeville and Saint-Acheul, up to the lance-heads with numerous facets and with elegantly undulated margins of the best time of the stone age in Denmark.

As to the epoch when the Reindeer ceased to inhabit what is now temperate Europe, we have no positive historical or chronological data. The Reindeer was never seen or clearly described by any author of antiquity. Cæsar speaks of it only from hearsay, and as an animal still existing somewhere in a forest, of which the extreme limits were not reached even after a march of sixty days. We have not recognized the Reindeer among the animals figured upon the ancient coins of Gaul. Its bones have not been found in the dolmens (tumuli) and other burying-places regarded as Celtic, in which the remains of wild and domestic animals are frequently associated, and in which we have even twice observed bones of the beaver in the vicinity of Paris. The Reindeer has not yet, so far as we know, been found in the French turbaries; nor have MM. Garrigou and Filhol indicated its presence in certain caverns of the Ariège, which they have justly assimilated, from their zoological characters and also from the presence of instruments of polished stones, with the most ancient lacustrine habitations of Switzerland. We know that the Reindeer is still wanting to the fauna of these lacustrine pile-works; and yet we have been able to examine its remains, derived from a neighbouring cave (that of Mont-Salève), in which the association of simply worked flints and of mammals belonging to the same period occurs under the same conditions as in our grottos of Périgord.

Thus, whether the disappearance of the Reindeer from temperate Europe be the result of a regional extinction of this species, or of its expulsion by the progressive development of human societies, or of its gradual and spontaneous retirement in consequence of changes in climatic conditions, it is not the less probable that this disappearance took place at a phase of prehistoric time anterior to the introduction of the domestic races and to the use of metals in western Europe.

BIBLIOGRAPHICAL NOTICE.

Flora Belfastiensis. The Plants round Belfast; with their Geographical and Geological Distribution. By RALPH TATE, F.G.S. 24mo. Belfast: G. Phillips & Sons. 1863.

THIS little book is well suited for the object contemplated by its author, viz. to be an assistance to the amateur botanists of Belfast. We are glad to learn by its publication that that is a numerous class there.

The district is interesting, and is shown by this list to be rich in plants. The number of geological formations is large, and the range in height extends from the level of the sea to the top of Black Mountain, at an elevation of 1272 feet. Excluding such plants as have small claim to be regarded as native, this little Flora records 602 species within a circle of from ten to fifteen miles' radius from Belfast. It is probable that its publication will cause some increase in that number, but we may doubt if it admits of much extension; for the author and his friends have apparently searched the country with acute and discriminating eyes. We should like to know what their *Papaver dubium*, *Viola canina*, and *Arenaria serpillifolia* really are.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

Nov. 10, 1863.—E. W. H. Holdsworth, Esq., F.Z.S., in the Chair.

NOTES ON THE SEBASTOID FISHES OCCURRING ON THE COAST OF CALIFORNIA, U. S. A. BY WM. O. AYRES, M.D., C.M.Z.S.

A remarkable feature in the ichthyic fauna of the coast of California is the occurrence of a large number of species belonging to the old genus *Sebastes*. They are taken in great quantities, and, being all of excellent quality for the table, they furnish a large proportion of the fresh fish sold in the markets of San Francisco. The different forms are readily distinguished by the fishmongers, though they sell them all under the absurd name of "Rock Cod." Their ichthyological history may be thus recorded.

In August 1854, *Sebastes auriculatus*, Girard, *S. rosaceus*, Gir., and *S. fasciatus*, Gir., were published in the 'Proceedings of the Academy of Natural Sciences of Philadelphia.' A few weeks later (in September), before the Philadelphia publication reached California, *S. nebulosus*, Ayres, *S. paucispinis*, Ayres, *S. ruber*, Ayres, and *S. ruber*, var. *parvus*, Ayres, were named in the 'Proceedings of the California Academy of Natural Sciences;' and in the same paper I indicated another species as perhaps *S. variabilis*, Cuv. Of these, *S. nebulosus* is identical with *S. fasciatus*, Gir. (but as the name *fasciatus* had been preoccupied by Dr. Storer for a species of Massachusetts Bay, *nebulosus* must be retained for the Californian species); *S. ruber*, var. *parvus*, is *S. auriculatus*, Gir. In November 1854, *S.*

nebulosus, *S. paucispinis*, *S. ruber*, and *S. variabilis* were mentioned again by me in the 'Proceedings of the Boston Society of Natural History.' In 1856 the species referred to by me under Cuvier's name *variabilis* was described by Girard as *S. melanops* (Proc. Acad. Nat. Sci. Phil. viii. p. 135). In 1858, in the tenth volume of the 'Pacific Railroad Reports,' Girard described all the species as he then understood them, giving my *S. ruber* as a synonym of his *S. rosaceus*,—an error on his part, since the two species are entirely distinct. In October 1859, *S. nigrocinctus*, *S. helvomaculatus*, and *S. elongatus* were described by me in the 'Proceedings of the California Academy of Natural Sciences.' Of these, *S. helvomaculatus* is considered by Mr. Theodore Gill (Proc. Acad. Nat. Sci. Phil., June 1862) as merely a synonym of *S. ocellatus*, Cuv. In 1861, Mr. Gill (Proc. Acad. Nat. Sci. Phil., July 1861) proposed to separate *Sebastes paucispinis* from the other species, under a new generic name, *Sebastodes*. In 1862 (Proc. Acad. Nat. Sci. Phil., June 1862) the same author proposed to include all the other Californian species in a new genus, to be designated *Sebastichthys*. In January 1863 (Proc. Cal. Acad. Nat. Sci. ii. p. 209) I described two new species, *Sebastodes flavidus* and *S. ovalis*. At the same date (*op. cit.* p. 211) I gave a brief sketch of what I believed to be the correct synonymy of the species now known on the coast of California.

Such has been, in brief, the series of notices and publications relating to these fishes. We have thus eleven species, all of which were (or would have been) until recently designated as *Sebastes*. A careful investigation of them all, with examination of very numerous specimens, has, however, convinced me that they must be arranged in two generic groups; and inasmuch as two generic names have, as above stated, been proposed for them by Mr. Gill, it is well to consider whether these names truly represent the two groups as seen in nature.

Of *Sebastodes* he gives the following diagnosis:—"This genus is framed for the *Sebastes paucispinis* of Ayres. It has a very different facies from *Sebastes*, and is readily distinguished by the longer body, the very protuberant lower jaw (which has a symphyseal swelling beneath), the minute scales, the form and armature of the head, the deep emargination of the dorsal fin, and the emarginated caudal." Such a grouping of characters as this belongs only to the single species, *S. paucispinis*. In the ratio of depth to length we have every step, from the "longer body" of *S. paucispinis* and *S. elongatus* (which two are of about equal slenderness, though in other respects they differ widely) to *S. ovalis* and *S. nigrocinctus*. And I may here take occasion to remark that the practice, in describing fishes, of giving the ratio of depth to length with such minuteness as is the custom of some writers, has no warrant in nature, since different individuals of the same species vary widely in their relative depth; and not only so, but the same individual varies widely at different times, according to the abundance or scarcity of food, and from other causes. The "emargination of the dorsal fin" is most decided in *S. flavidus*, while the least emargination of all occurs in *S. elongatus*, and the next to that is in *S. ovalis*, which latter, however, is most closely allied to

S. flavidus. The "emarginated caudal" is a feature so slightly marked at the best, and disappears so gradually from one species to another, as to be of very little value. It is greatest in *S. paucispinis* and *S. elongatus*, and becomes less through *S. ovalis*, *S. flavidus*, *S. melanops*, *S. rosaceus*, and *S. helvomaculatus*; in *S. ruber* and *S. auriculatus* the fin is about even, and in *S. nebulosus* and *S. nigrocinctus* it is slightly rounded. The "protuberant lower jaw" and its "symphyseal swelling beneath" are of greater value as generic features; they are common to five of our species. These five have the lower jaw (which is knobbed at its extremity) continuing nearly the line of extension of the top of the head; in these five the top of the head is smooth and unarmed. In the remaining six species the two jaws are but little unequal, and the lower is blunt and does not continue the line of extension of the top of the head; in these six the top of the head is strongly ridged and spinous. But when we look at the species of other waters, we find that the relative development of the jaws can scarcely hold such rank as our groups here would seem to indicate. *Sebastes viviparus*, for instance, with the surface of the head very rough and spinous, has the knobbed projection of the lower jaw strikingly developed. The "minute scales" belong only to *S. paucispinis*. It does not seem possible, therefore, that *Sebastodes* can be retained with such limits as were assigned to it by Mr. Gill.

Let us now turn to his definition of *Sebastichthys*. He assigns as its characters "eleven to twelve (XI. + I.—XII. + I.) spines in the first dorsal fin, palatine teeth, and the physiognomy of *Sebastes (norvegicus)*." But all of our species, *S. paucispinis* included, have the same number of spines in the first dorsal fin—thirteen, or, if a division is preferred, XII. + I.; and all are furnished with teeth on the palatines. Neither can the "physiognomy" be deemed of value, inasmuch as forms so very unlike are here gathered into one group: the rough, blunt-headed *S. nigrocinctus* has little kindred in features to the smooth, sharp-nosed *S. melanops*. And as *S. norvegicus* itself is provided with palatine teeth, the only character remaining to separate *Sebastichthys* is the number of first dorsal spines. This, unsupported, does not appear sufficient.

The divisions of our Californian species, therefore, which have been proposed by Mr. Gill I cannot adopt, though one of his names may be retained with a different limitation.

Of the two groups which, as before stated, I find to exist in our waters, one has the top of the head rough, the other has it smooth. The former I refer without hesitation to the genus of which the common species of Massachusetts Bay, *S. viviparus*, is a member; and, since Cuvier in his original diagnosis separates *Sebastes* from *Scorpena* in consequence of the absence of fleshy filaments on the head, it seems most natural in making a division of his genus that the name *Sebastes* should be retained for those which, like *Scorpena*, have the top of the head rough with ridges; and I propose thus to restrict it. For the other group (those with the head smooth) a distinct generic name is needed; and since the appellation *Sebastodes*

has been proposed for one of the well-marked species, it seems better to apply that to the entire group than to introduce a new term. I suggest, therefore, the following arrangement:—

Gen. SEBASTES.—*With the characters of Sebastes as given by Cuvier, except that the top of the head is always marked by spinous ridges, the orbits being commonly crested, so as to leave a depression between them.*

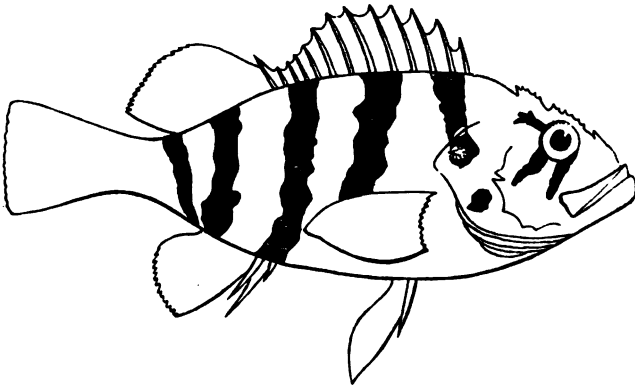
Gen. SEBASTODES.—*With the characters of the typical Sebastes, except that the top of the head is always smooth, the spinous ridges being so little developed as to be barely discernible, the orbits not elevated.*

In what manner the species of other waters should be distributed under this division I do not purpose at present to specify. The means of reference to original authorities are here, unfortunately, so small as to make the attempt useless. The Californian species, however, hitherto discovered may be arranged and designated thus:—

1. SEBASTES NIGROCINCTUS, Ayres, Proc. Cal. Acad. Nat. Sci. ii. p. 25, and p. 217, fig. 67.

Sebastichthys nigrocinctus, Gill, Proc. Phil. Acad. Nat. Sci. 1862, p. 278.

This is more strongly marked in the generic features than any other of our species. The spines of the top of the head are very prominent; the nasal spines strong, while nearly continuous from them are a pair of slender interorbital ridges; the supraorbital crest



sometimes a single ridge, and sometimes a series of spines or tubercles; posterior to these a row of blunt tubercles, extending across the top of the head, varying in number from two to five or six; posterior to these the occipital ridges, very high, and commonly not terminating in a spine. The posterior suborbital terminates in a distinct spine. The preopercular spines are less prominent than in most of the species, consisting of two, or at most three, on the posterior border, with one or two rounded but not spinous projections

beneath. The humeral suprascapular and two opercular spines are of moderate development. The spinous and soft dorsals are about equal in height, the spinous rays quite stout. The second anal spine is higher and stronger than the third.

The colours in this species are entirely characteristic, and very strongly marked. The fish is of a plain reddish yellow, crossed by five to six very distinct, nearly vertical, broad, dark bands, with commonly two or three similar bands from the eye, one upward and backward, and the others downward and backward. These bands in my original description were said to be black, and the specific name was given with that understanding. But I have since that time seen specimens in which the bands were of a dark reddish brown when fresh from the water, and became black only on the drying of the surface or on immersion in alcohol.

S. nigrocinctus is not at all common in our waters, many months often passing without a specimen being taken. It seldom exceeds two pounds in weight.

2. *SEBASTES NEBULOSUS*, Ayres, Proc. Cal. Acad. Nat. Sci. i. p. 5.

S. fasciatus, Gir. Proc. Phil. Acad. Nat. Sci. 1854, p. 146, and P. R. Rep. x. p. 79, pl. 22 (non *S. fasciatus*, Storer, Proc. Bost. Soc. Nat. Hist. v. p. 31).

Sebastichthys nebulosus, Gill, Proc. Phil. Acad. Nat. Sci. 1862, p. 278.

In this species the spines of the top of the head are less prominent than in *S. nigrocinctus*. The nasal and anterior supraorbital are sharp, rather strong; the posterior supraorbital a smooth prominent ridge, ending in a strong spine; the intraorbital space smooth, not ridged as in *S. nigrocinctus*; postorbital spine sharp and strong; occipital spine a long smooth ridge, prominent, but not near so high as in *S. nigrocinctus*, and ending in a sharp spine; no spines on the suborbitals; humeral, scapular, and opercular spines flat, and not prominent; preopercular five, well developed, rather sharp, the two on the lower border more blunted. Spinous dorsal much higher than the soft; second anal spine higher and stouter than the third.

The colours are sufficiently well stated by Girard (*loc. cit.*). *S. nebulosus* is by no means rare, and is found in the markets of San Francisco at all seasons, seldom exceeding two pounds in weight.

3. *SEBASTES AURICULATUS*, Gir. Proc. Phil. Acad. Nat. Sci. 1854, and P. R. Rep. x. p. 80.

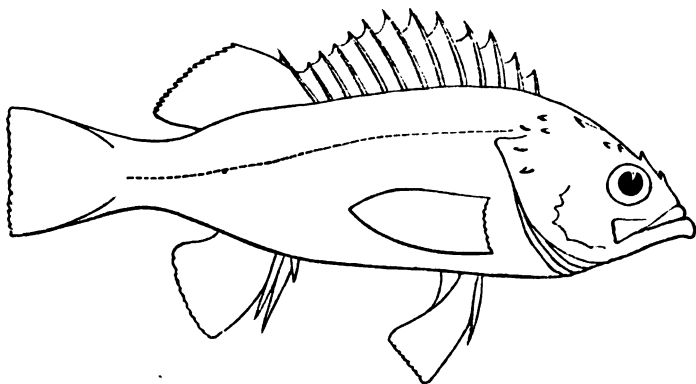
S. ruber, var. *parvus*, Ayres, Proc. Cal. Acad. Nat. Sci. 1854, i. p. 7.

Sebastichthys auriculatus, Gill, Proc. Phil. Acad. Nat. Sci. 1862, p. 278.

Sebastes auriculatus, Ayres, Proc. Cal. Acad. Nat. Sci. ii. p. 218, fig. 68.

All the spines of the top of the head regular, smooth, strongly marked, but not very prominent. Nasal stout and sharp; anterior

and posterior supraorbitals strong and sharp, but not so elevated as to make much depth to the intraorbital fossa; intraorbital ridges just discernible; postorbital spine slender, very sharp; occipital ridge smooth, somewhat prominent, not spined. Upper two preopercular spines sharp, next two flattened and serrated or edged, anterior one blunt. Humeral, scapular, and two opercular spines flat, not prominent; lower angle of operculum serrated. Spinous dorsal a little higher than the soft portion, or sometimes only equal. Second anal spine as high as the third, and stouter.



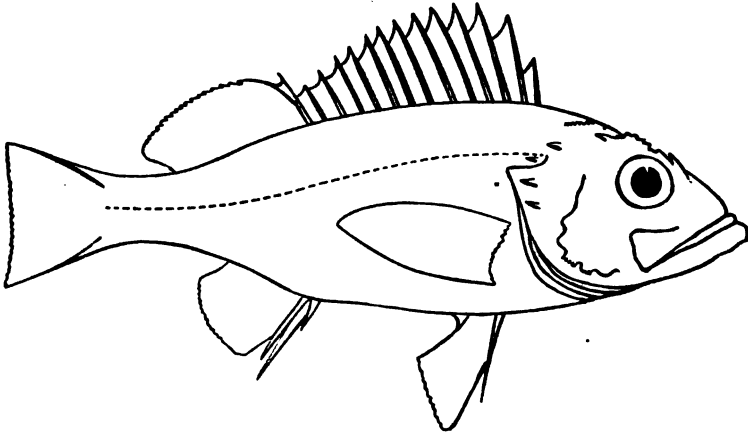
The colours are stated with sufficient accuracy by Girard (*loc. cit.*). *S. auriculatus* is perhaps the most common species we have, and is almost the only one taken about the wharves of the city. The examples for the most part small, seldom exceeding half to three-quarters of a pound in weight, though those brought in by the fishermen from the deep water are much larger; the heaviest I have seen was 20 inches long, with a weight of six pounds. In the large specimens the black spot of the operculum becomes almost obsolete.

The typical specimens of *S. nebulosus* and *S. auriculatus* are quite widely distinct; but so many intermediate forms occur, that not unfrequently it is actually very difficult to decide to which of the two certain individuals should be referred. The spines and ridges of the head I have found more reliable as means of diagnosis than any other features.

4. *SEBASTES RUBER*, Ayres, Proc. Cal. Acad. Nat. Sci. i. p. 7, and ii. p. 208, fig. 63 (non *S. rosaceus*, Gir. P. R. Rep. x. p. 78).

Top of the head quite rough, the ridges being thinner and more irregular on their edge than in the other species. Nasal spine sharp and rather strong; supraorbital crest consisting of an anterior spine which is distinct and regular, and then an elongated irregularly serrated ridge, not ending in any very distinct spine; postorbital spine not large, but quite sharp, distinct, and regular; intraorbital pair of

ridges low and not much crested, but quite discernible; occipital ridge long, about as high as in *S. nebulosus*, irregularly serrated, and not ending in any very distinct spine; the upper two preopercular spines rather sharp, the next two flattened and serrated on the end, the anterior one blunt; opercular spines flat; humeral and scapular small. Second and third anal spines about equal in height and size. Spinous dorsal higher than the soft portion. Posterior margin of the caudal nearly even. Colour nearly uniform light crimson, lighter beneath.



This is the species described by me in 1854 (*loc. cit.*), but is not the one to which the name is referred by Girard (P. R. Rep. x. p. 78) as a synonym of *S. rosaceus*. The two have little close resemblance, except in colour. The points of difference will be given when speaking of *Sebastodes rosaceus*.

S. ruber is not at all rare. It grows to decidedly a greater size than any of the other species, reaching occasionally a weight of twenty-five pounds, and, as the fishermen assert, even greater still, while those of from ten to twelve pounds are quite common.

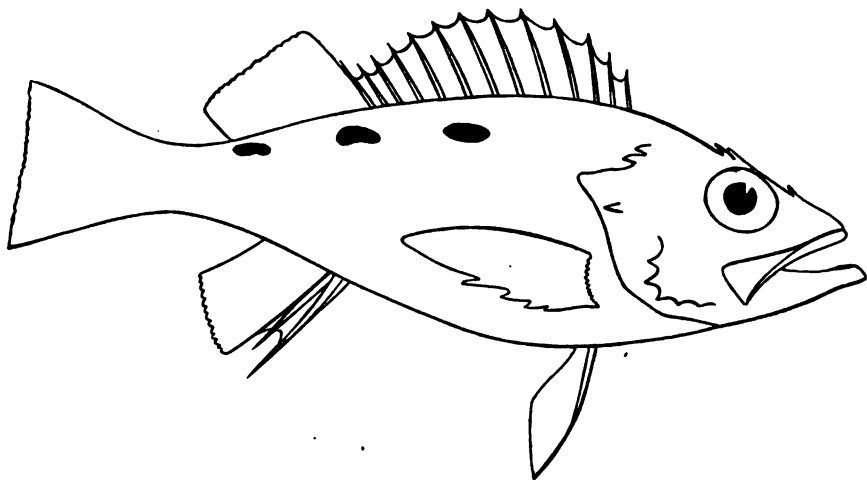
5. *SEBASTES HELVOMACULATUS*, Ayres, Proc. Cal. Acad. Nat. Sci. 1859, ii. p. 26, fig. 8.

S. ocellatus?, Cuv. (*vide* Gill, Proc. Phil. Acad. Nat. Sci. 1862, p. 278).

Sebastichthys ocellatus, Gill (*loc. cit.*).

Upper surface of the head quite strongly ridged. Nasal and anterior supraorbital spines sharp, quite prominent; posterior supraorbital forming a crest, which ends in commonly two prominent sharp spines; intraorbital fossa well marked, with two intraorbital ridges; postorbital spine appearing like a continuation of the posterior supraorbital, prominent, very sharp; occipital ridge somewhat

elevated, ending in a free spine; of the preopercular spines, the upper two are well developed, not very sharp, the lower three forming blunt projections; two opercular spines sharp, not very long. Humeral and scapular somewhat prominent. Spinous dorsal a little higher than the soft portion. Second anal spine higher than the third, and much stouter.



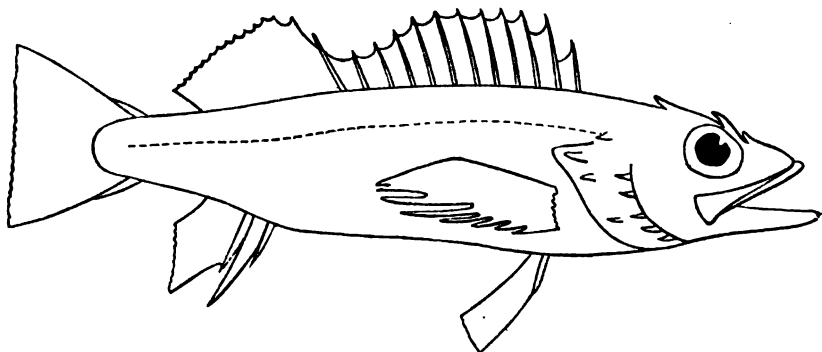
Colour pale red, becoming lighter beneath, with several light-pink spots on the upper parts of the sides. These spots are commonly three, though occasionally one or two additional irregular ones are seen. Sometimes in the largest specimens the light red of the ground-colour is variegated with numerous minute whitish specks.

The outline figure (given above) represents the projection of the lower jaw a little more strongly marked than it should be; and shows also but the lower of the two opercular spines, giving instead one too many on the præoperculum. Otherwise, though rough, it is tolerably characteristic.

S. helvomaculatus is not by any means rare, being brought to the markets of San Francisco in some numbers. They are commonly small, not exceeding a pound in weight, though specimens weighing three to four pounds are sometimes seen. This species has been referred by Mr. Gill (*loc. cit.*) to the South American form described by Cuvier, *S. ocellatus*. The identification may perhaps be correct, for the two doubtless approach each other closely; but the difference in proportions, in the spines of the head, and in the colouring of the fins, and the wide separation in localities, together with the fact that no specimens have been brought to me among numerous collections made on this coast south of Point Conception, have induced me to retain, at least for the present, the name given to our northern species.

6. *SEBASTES ELONGATUS*, Ayres, Proc. Cal. Acad. Nat. Sci. ii. p. 26, fig. 9.

Nasal spine sharp, quite prominent; anterior supraorbital well marked, sharp; posterior supraorbital forming a crest quite sufficient to leave an intraorbital fossa, and terminating in a sharp spine; postorbital just discernible; occipital ridge smooth, low, with a free point. Opercular, preopercular, humeral, and scapular spines prominent and sharp. Inferior angle of operculum and posterior angle of suboperculum spinous. Second anal spine higher and much stouter than the third. Spinous dorsal about equal in height with the soft portion.



S. elongatus is readily distinguished from all the other species of true *Sebastes* by its extreme slenderness, in which respect it closely resembles *Sebastodes paucispinis*, sometimes even surpassing it. The proportion of depth to length varies from about one-fifth to nearly one-fourth. The figure (given herewith) represents the first specimen found, which was as slender as any I have seen. In the figure a spine is inadvertently shown on the lower part of the operculum, while the scapular is omitted; the knobbed projection of the lower jaw is not sufficiently indicated. The colours are well stated in the original description.

The species appears to be not at all common, few being brought to the markets. They seldom exceed a pound in weight.

SEBASTODES.

In the species of this division no diagnostic characters can be drawn from the spines of the head, as so little difference is found in them. In all, the nasal, supraorbital, and occipital spines are barely discernible, or cannot be traced at all; the five preopercular are quite strongly developed, smooth, and sharp (except that in *S. paucispinis* the lower one is a blunt projection, with one, and sometimes two sharp points); the opercular two are long and sharp; the hu-

meral and scapular are almost concealed. The specific distinctions, therefore must be drawn from other features. The species may be arranged and defined as follows:—

1. *SEBASTODES PAUCISPINIS*.

Sebastes paucispinis, Ayres, Proc. Cal. Acad. Nat. Sci. i. p. 6 ; Gir. P. R. Rep. x. p. 83, pl. 22 A.

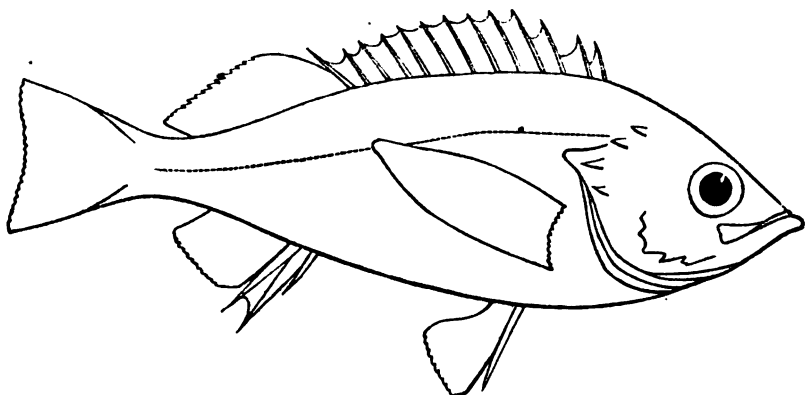
Sebastes paucispinis, Gill, Proc. Phil. Acad. Nat. Sci. 1861, p. 165.

This species is quite elongated in form, its depth being about one-fourth of its length. The spinous dorsal is arched in outline, the emargination between it and the soft portion being very distinct, though less strongly marked than in *S. flavidus* or *S. melanops*. The head is longer than in most species, constituting fully one-third of the entire length. But the feature by which *S. paucispinis* is at once recognized is the "small scales." They are relatively less than in any other known species, and are accompanied by a general softness of flesh, which causes the fish to be less esteemed for the table than any other of the group found in our waters. The description and figure given by Girard are tolerably accurate.

S. paucispinis is not by any means common in this vicinity. It is taken in company with the other species; but no more than a single specimen at long intervals is seen in the markets. It attains a length of 25 to 28 inches.

2. *SEBASTODES OVALIS*, Ayres, Proc. Cal. Acad. Nat. Sci. ii. p. 209, fig. 65.

This species is much stouter than *S. paucispinis*, its depth being nearly one-third of its length. Its closest alliances are with *S.*



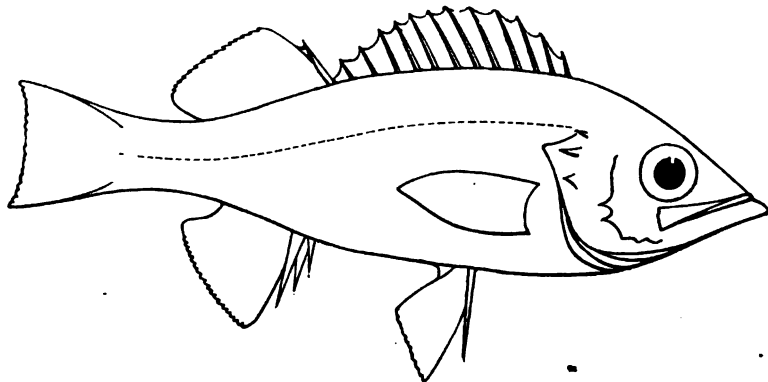
flavidus, Ayres, and *S. melanops*, Gir. The spinous dorsal decreases but little in height posteriorly, leaving of course but a slight emargination between it and the soft portion, which latter is low, its height

being less than half its length. The pectoral fins are large, their height being about one-fourth the length of the fish. Of the three spines of the anal fin, the second is the highest and stoutest, equalling the height of the soft portion of the fin. In colour the fish is of a dark greenish brown above, becoming yellowish green on the sides, and still lighter beneath. In regard to the softness of the scales it comes nearer than any other species to *S. paucispinis*, though they are relatively much larger than in the latter.

S. ovalis appears to be quite rare, only a few specimens having been seen. None have exceeded three pounds in weight.

3. *SEBASTODES FLAVIDUS*, Ayres, Proc. Cal. Acad. Nat. Sci. ii. p. 209, fig. 64.

This species is so closely allied to *S. melanops*, Gir., as scarcely to be distinguished from it, except by its colours. *S. melanops* is nearly black above, lighter on the sides and beneath; while *S. flavidus* is like *S. ovalis*, "dark greenish brown above, becoming yellowish green on the sides, and still lighter beneath."



S. flavidus is by no means uncommon, being brought to the markets in abundance. It seldom exceeds two pounds in weight.

4. *SEBASTODES MELANOPS*, Gir.

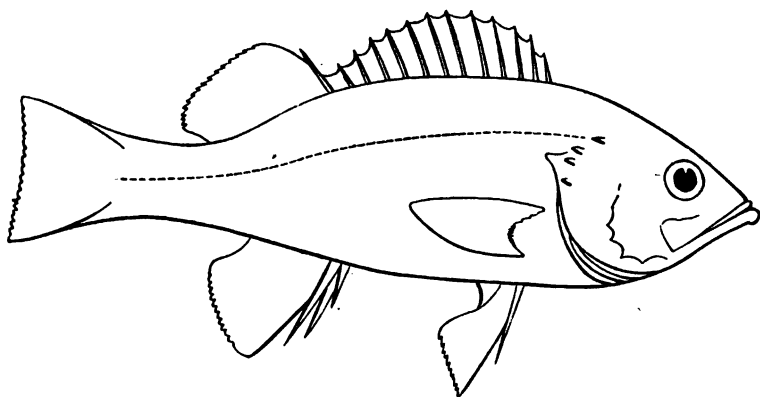
Sebastes melanops, Gir. Proc. Phil. Acad. Nat. Sci. viii. p. 135; and P. R. Rep. x. p. 81.

Sebastes variabilis, Ayres (non Cuvier), Proc. Cal. Acad. Nat. Sci. 1854, i. p. 7.

Sebastodes melanops, Ayres, Proc. Cal. Acad. Nat. Sci. ii. p. 211, fig. 66.

This species is sufficiently well described by Girard (*loc. cit.*); but inasmuch as no figure is given by him, reference may be made to the outline illustration given herewith (p. 341), which is accurately reliable.

S. melanops is quite common here, and is brought to the markets in large numbers. It is generally small, not exceeding a pound in

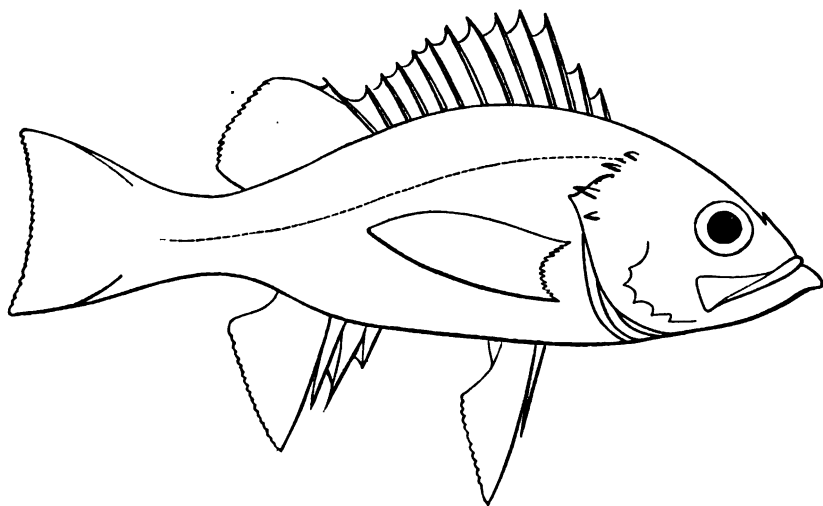


weight, though it occasionally attains a weight of three or four pounds.

5. *SEBASTODES ROSACEUS*, Gir.

Sebastes rosaceus, Gir. Proc. Phil. Acad. Nat. Sci. viii. p. 146 ; and P. R. Rep. x. p. 78, pl. 21 (non *Sebastes ruber*, Ayres, Proc. Cal. Acad. Nat. Sci. i. p. 7).

Sebastodes rosaceus, Ayres, Proc. Cal. Acad. Nat. Sci. ii. p. 206, fig. 62.



This is the species originally described by Girard (*loc. cit.*) under the name *rosaceus*, and again quite correctly in the tenth volume of the 'Pacific Railroad Reports.' In this latter publication he incorrectly refers my *Sebastes ruber* to it as a synonym. The two are widely distinct: *S. ruber* has the top of the head strongly ridged and spinous, as already stated in this present communication; *S. rosaceus*, as its generic affinities indicate, has the same region almost entirely smooth, the nasal and occipital spines being barely discernible: in *S. ruber* the preopercular spines are blunt, almost truncated; in *S. rosaceus* the same spines are long and very sharp: in *S. ruber* the anal fin is small and rounded, its height being only about one-eighth of the length of the fish, while the second and third spines of the fin are nearly as high as the soft portion; in *S. rosaceus* the same fin is much larger and pointed, its height being more than one-sixth of the length of the fish, while the third anal spine (which is higher than the second) is only about half as high as the soft portion. Many other points might be noticed, but these are sufficient. The outline figures show very clearly the relations of the two species.

Sebastes rosaceus is quite common. It is a smaller fish than *Sebastes ruber*, seldom exceeding five or six pounds in weight.

The eleven species thus indicated are brought to the markets of San Francisco at all times of the year, the fishery being little affected by the seasons. They are taken with the hook, in the open sea, near the Bay of San Francisco, wherever rocky bottom is found. One species only, *Sebastes auriculatus*, is caught about the wharves of the city. The spawning-season is from March to June; and in all the species the development of the young takes place within the body of the mother, but to what degree I have not yet the means of stating with absolute accuracy. I have traced them to such a stage of advancement that the mouth, the intestinal canal, the vertebral divisions, and the vertical fins were all plainly discernible, and of course the eyes strongly marked and prominent, the embryo on being removed from the egg being fully half an inch in length.

NOTES ON THE KAGU. BY DR. GEORGE BENNETT, F.Z.S.

On the 13th of June 1863, I received from New Caledonia, by H. I. M. Schooner 'La Calédonienne,' a pair of Kagus (*Rhinochetus jubatus*), male and female—one presented to me by Dr. Segol, the surgeon of the vessel, and the other obtained and sent to me by the kind exertions of M. Ferdinand Joubert, now residing in New Caledonia. Both these gentlemen have been indefatigable in endeavouring to procure living specimens, the value of which is much raised by the increased scarcity of Kagus on the island. The day following their arrival I placed them in the aviary in the Botanical Gardens. The female is a fine bird, and the largest specimen of the Kagu I have yet seen. It is graceful and elegant in appearance, active and lively in its habits, and its plumage in excellent condition. It is distinguishable from the male bird by its much larger size, and by the light colour of its plumage, also of its bill, feet, and legs. She has besides a peculiar habit of crouching on the ground and covering herself with her wings, by throwing them over together in a concave

form, completely concealing the head and body. The male bird, on the contrary, throws up his wings alternately, as if using them as shields, and displays much pugnacity. The latter differs in colour from the female, his plumage being dark brown, with bars of a lighter shade; the primaries and secondaries of the wings are very dark brown, barred with black; the crest is also of a much darker shade of grey than in the female; the bill and legs are of a bright orange-red colour. When seen together, the male appears small compared with the female. The latter utters a growling kind of scream; while the male makes a noise between a bark and a laugh, which is difficult to express in words, terminating in the oft-repeated note of *ōō, ōō, ōō, ōō*. The male bird is very lively, and readily attacks its aggressors.

The Kagu is becoming very scarce in New Caledonia,—one cause of its rarity being that numbers have been shot for the table, these birds being excellent eating. It is now difficult to procure them dead, and still more so to take them alive. They are only found in one part of the island, about ten miles distant from the settlement of Port de France, where a gentleman told me he offered a large reward to the natives to procure one to take with him to France, but without success. The birds sent to me had been in the possession of private individuals for some time. The Kagus are easily domesticated, and, when captured, are placed in the poultry-yard with the fowls, where they soon become tame; but, as a matter of precaution, one of their wings is usually clipped. These birds are only met with about small marshes or ponds, feeding on worms, slugs, &c. The nest and eggs have not yet been discovered, although every exertion has been and is still being made by some of my resident friends in New Caledonia for that purpose.

MISCELLANEOUS.

On Alternate Generation in the Annelida, and the Embryology of Autolytus cornutus. By A. AGASSIZ.

FROM the works of Oersted, Grube, J. Müller, Max Müller, and Keferstein, it appears that *Autolytus* presents the rare peculiarity among Annelides of a striking polymorphism, the males being indeed so different from the females that the two sexes have been described as belonging to distinct genera. There exists also in each species a third form, namely, the asexual form, which produces the sexual individuals by gemmation at its posterior extremity—the alternation of generations in these worms being now well established.

Mr. A. Agassiz has found in the harbour of Boston the *Autolytus* of which the males were described by Oersted, in 1843, under the name of *Polybostrichus setosus*, from Greenland. He has likewise observed, in the same locality, another species, to which he gives the name of *Autolytus cornutus*—a species which appears to be nearly related to the European *Autolytus* (*Sacconereis*) *Helgolandiae*. The differences between the individuals of the two sexes are of the same nature as in the European species. The females, at the moment of their detachment from the organic individuals, possess no ovigerous

sac. This sac is soon formed, and the ova are deposited in its interior. The embryos are rapidly developed, and their escape from the sac appears to cause the death of the female; at least, Mr. Agassiz has never met with females after their embryos have escaped. The embryos at the moment of issuing from the sac have a triangular outline, their body diminishing rapidly towards the posterior extremity. The development of these embryos presents an example of the most simple evolution observed among the Polychætic Annelides.—*Journ. Bot. Soc. Nat. Hist.* viii. p. 392.

Note on the Reproduction of the Larvæ of Insects.

By Professor NICOLAS WAGNER, of Kasan.

Professor N. Wagner has discovered a fact in the natural history of insects which at first sight appears incredible; but, as it is supported by preparations, the inspection of which by Prof. de Filippi completely convinced him of the truth of Prof. Wagner's observations, a short notice of the singular results arrived at by the latter cannot but be acceptable to our readers.

In June 1861 Prof. Wagner found, under the bark of a dead elm in the vicinity of Kasan, some whitish apodal worms, the organization of which proved them to be larvæ of insects. Each of these larvæ was filled with smaller larvæ. This was nothing remarkable, as cases of parasitism are well known to be exceedingly frequent among insects. But Prof. Wagner was justly struck by the fact that the included larvæ were perfectly identical, even to the smallest details, with the enveloping larvæ. By this identity he was led to assume that the included larvæ represented a second generation produced by the enveloping larvæ. This would therefore be a case of alternation of generations even more surprising than that of the Aphides.

Improbable as this interpretation may appear at the first glance, it has several circumstances in its favour. Amongst these the principal are the following:—

1. It seems impossible to assume that a parasitic larva can present an organization perfectly identical with that of the organism which nourishes it.

2. The parasites which deposit their eggs in a single insect, deposit the whole at once, and these eggs are simultaneously developed. But Prof. Wagner found in one and the same enveloping larva included larvæ presenting the most various phases of development.

3. Parasitism is an accidental phenomenon, whilst all the larvæ observed presented included larvæ at a certain degree of development.

4. The size of the eggs of a given species is constant, whilst the reproductive bodies which here play the part of eggs exhibit very considerable variations of size.

5. In the interior of the larvæ of the second generation a third generation is produced, precisely similar to the first two.

Professor Wagner has observed three other species of the same genus, all presenting this singular mode of reproduction. The perfect insects are still unknown. From the appearance of the larvæ, they seem to belong to the order Diptera.—*Siebold und Kôlliker's Zeitschrift*, 1863, p. 544.

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[THIRD SERIES.]

No. 77. MAY 1864.

XXXV.—*On the Construction and Limitation of Genera among the Hydroida.* By Prof. ALLMAN, F.R.S.

It will assuredly seem strange that those principles of classification which have been acknowledged as the only sound ones, and which have been our guide in the study of every other group of the animal kingdom, should be almost entirely ignored in our attempts at a systematic arrangement of the HYDROIDA.

The cause of this, however, is sufficiently obvious. The individual Hydroid frequently presents itself in disconnected parts, which are very different from one another; and it is only recently that the researches of zoologists have shown the mutual relation of these parts, and have demonstrated that organisms now enjoying an independent life may have been at one time united in a single individual, and are at all times necessary for an adequate conception of it. So long, however, had the practice prevailed of regarding these component elements of the zoological individual as if they were entirely independent of one another, that even still we find it more convenient to treat them as such, to assign to them separate places in our systems, and record them under distinct generic and specific names.

Yet this is totally at variance with the first principles of natural classification and of a scientific nomenclature; and the sooner we get rid of it the better for the harmony of biological method, and the progress of that department of zoology in which it has prevailed.

For many years it has been known that a considerable number of the fixed Hydroida give origin to buds which detach themselves from the fixed stock, and henceforward lead an independent life in the open sea as free gymnophthalmic Medusæ. The first who entertained, or at least gave definite expression to, the true relation between these two sets of elements in the Hydroid seems to have been Dujardin, when he compared the

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polypoid portion to the vegetative mycelium of a mushroom, and the medusoid portion to the reproductive hymenium, with its protecting parts*. The polypoid and medusoid elements, however, still continued to be treated as primarily independent organisms, receiving each separate generic and specific names; and indeed the time had not yet come when any other plan was practicable; for the number of free Medusa-forms which had been traced to fixed polypoid forms was far too small to render possible any more philosophic system.

Observations, however, gradually accumulated, and at length we became aware of a sufficient number of cases in which the connexion between the polypoid and medusoid elements was apparent to justify an attempt at combining the two in our classification.

Accordingly we find, in an excellent and conscientious paper by M'Crady†, an attempt made to combine the two elements in his arrangement of the so-called Gymnophthalmic Medusae. M'Crady, however, gives a disproportionate prominence to the medusoid element, and in his nomenclature shows a tendency to adopt a more recent name by which the Medusa may have been known, rather than the older one under which the polypoid element has become familiar to us.

Agassiz, in the fourth volume of his 'Contributions to the Natural History of the United States,' also shows himself impressed with the necessity of combining both elements, in order to allow of our forming an adequate conception of the Hydroid, while he gives no undue prominence to one of these elements over the other, and sees the justice of adopting for the entire Hydroid the name by which it was first systematically described, whether under the form of the free Medusa or of the fixed Polypite-colony. He has thus been frequently compelled to a dismemberment and a redistribution of existing generic groups, as well as to the construction of several new ones. Agassiz has here largely extended our knowledge of the HYDROIDA, and has made an important advance to a philosophic classification of the group; but I cannot admit that he has always made a correct estimate of the value of the characters which he employs in the construction of his genera, while he more than once overlooks the just claims of existing names to adoption.

The necessity of combining the two elements in our conception, description, and classification of the Hydroida is also maintained in a series of excellent papers published in the 'Natural

* Dujardin in *Ann. des Sc. Nat.* 1845.

† M'Crady, "Gymnophthalmata of Charleston Harbour," in the *Proceedings of the Elliott Society of Natural History of Charleston, South Carolina*, 1859.

History Review' (1861-63), where they appear under the form of a review of the work of Agassiz just referred to—papers in which there is no difficulty in recognizing the pen of an accomplished zoologist who holds a chair in an Irish University, and is already well known by his valuable contributions to the literature of the *Cœlenterata*.

I believe that henceforth no classification of the HYDROIDA will be admitted by the zoologist which does not include in the conception of every Hydroid both those parts which are destined for the nutrition of the colony and those which are destined for the sexual perpetuation of the species, whether these last are in the form of fixed sacs or of free locomotive Medusæ.

It must be borne in mind that every Hydroid whose life-history has come fully before us consists (with only a single positively proved exception*) of two sets of zooids. One of these is destined for the nutrition of the colony, and has nothing to do with true generation; while the other is, on the contrary, destined for true generation, and has nothing to do with the nutrition of the colony. For the whole assemblage of the former I have elsewhere† proposed the term "trophosome," and for that of the latter the term "gonosome;" and whether the gonosome remains permanently attached to the trophosome or becomes in whole or in part free, attaining thereby an independent existence, it is equally necessary that it should take its place in our diagnosis of genera and species. An adequate conception of the Hydroid can thus only be obtained by regarding it as the product of two factors, one of them finding its expression in the trophosome, and the other in the gonosome.

Now the characters to which we shall be justified in assigning a generic value will be found in both of these factors. The trophosome will present them chiefly in the form of the polypite, including the arrangement and structure of the tentacles (whether these be scattered or in one or more verticils, or whether they be filiform or capitate), in the solitary or associated condition of the polypites, and in the nature and extent of the chitinous periderm. In the gonosome, characters of generic value will be found in the mode of origin of the gonophores and in their general form—whether they be in the condition of a fixed sac (*adelocodonic*) or of a developed Medusa (*phanerocodonic*); while each of these forms of gonophore may itself present differences which will afford characters of value in the limitation of our genera. It is true that among the *adelocodonic* forms it is rare to meet with any differences so well marked as to be-

* See my "Report on the Reproductive System of the Hydroids," in the Report of the Newcastle Meeting of the British Association, 1863.

† *Loc. cit.*

come of generic value; but among the phanerocodonic forms the differences are numerous and important—differences which, though they are fully recognized so long as we regard the Medusæ as independent organisms, are yet usually ignored when we see in the Medusa only the sexual bud of a polypoid trophosome. They will be found in the form of the umbrella, in the form and development of the manubrium, in the situation of the generative elements, in the number and distribution of the radiating canals, in the structure of the marginal tentacles, and even in their number when we have reason to regard this number as permanent and not merely as the result of an immature condition, and, finally, in the presence or absence of lithocysts, and even in the position which these bodies hold on the umbrella-margin,—all which characters, either singly or combined, will afford valid grounds for the construction of our generic groups.

The classification of the HYDROIDA would be a comparatively simple task if, as has been erroneously asserted, generically identical medusoids always arose from generically identical polypoids, and, on the other hand, that generically identical polypoids always gave origin to generically identical medusoids.

This, however, is far from being the case; and the history of the Hydroida renders us acquainted with two phenomena which signally break the uniformity assumed in the above propositions.

The phenomena to which I refer are, (1) the association of similar gonosomes with dissimilar trophosomes (*isogonism*); and (2) the association of dissimilar gonosomes with similar trophosomes (*heterogonism*). The difficulties which these phenomena throw in the way of a natural classification of the Hydroida may be compared to those which the mineralogist meets with when he finds isomorphism and dimorphism interfering with the uniformity of his mineralogical system.

But the great difficulty, after all, in the application of the method here advocated is found in the fact that the Medusa at the time of its liberation is still in an immature state, and may be destined to undergo important changes before arriving at its adult condition. In such cases, unless we have succeeded in following the Medusa to its ultimate form, our determination of its type must be regarded as only approximative. Analogy, however, will greatly aid us in this determination, by pointing out what are the parts most liable to change, and what the direction in which this change is likely to take place.

From these considerations we learn that the number of marginal tentacles in the recently liberated Medusa must be accepted with great caution as affording valid systematic characters, these organs being especially liable to an increase in number as the Medusa advances towards maturity. In some cases, however,

we may fairly assume the number presented by the marginal tentacles in the young Medusa as representing their permanent condition, as, for example, in the single long tentacle of the Medusa in *Corymorpha*, where we find, by going back to the early stages of the development of this Medusa, that the peculiar asymmetrical form which, in a later stage, finds its expression so decidedly in the great development of a single tentacle is quite apparent before any trace of a tentacle can be detected.

With regard to nomenclature, I am convinced that, except in certain special cases, we must give to our Hydroid the name under which it was first described, whether this name may have been originally given to the trophosome or to the gonosome. The fact of our giving as a generic name to the complete Hydroid that by which the Medusa had been previously known needs not prevent our employing the same name for all those similar Medusæ whose trophosome has not yet been discovered; but we must keep in mind that the name, when used in this sense, is purely provisional, and liable to be changed when the discovery of the trophosome shall determine the true genus of our then no longer incomplete Hydroid.

It is upon the principles here urged that I have drawn up the following synopsis of the genera and species of the Tubularian and Campanularian Hydroids. I have confined myself, however, entirely to those forms in which the trophosome is known, the numerous free Medusæ which have not been traced to a trophosome, or been proved to originate by direct development from the egg, holding places in our system which must for the present be regarded as altogether provisional.

In the generic descriptions I have adopted as far as possible a uniformity in the selection of characters and in the order in which these characters are noted; and I have further, by availing myself of terms already in use, and by introducing one or two new ones, been able to avoid tedious circumlocution, and to condense the descriptions without sacrificing their precision.

In order that the synopsis may be more easily followed, it will be well to give here definitions of the principal terms used, while for a fuller exposition of the terminology of the Hydroids I must refer to Prof. Huxley's 'Oceanic Hydrozoa,' published by the Ray Society, and to some papers of my own, more especially a paper "On the Structure and Terminology of the Reproductive System in the Corynidiæ and Sertulariadiæ," published in the 'Annals and Magazine of Natural History' for July 1860, and a "Report on the Reproductive System of the Hydroids," in the Report of the Newcastle Meeting of the British Association, 1863.

The terms "trophosome" and "gonosome" have been already

defined in the present paper; the "cœnosarc" is the common connecting basis of the colony, and is more or less completely invested by a chitinous "periderm" excreted from its surface; the "hydrorhiza" (Huxley) is the root-like proximal termination of the cœnosarc by which the Hydroid attaches itself to foreign bodies; the "hydrocaulus" is the free or (in certain creeping forms) more or less adherent portion of the cœnosarc, which intervenes between the hydrorhiza and the polypites; the "metastome" is that portion of the polypite which intervenes between the mouth and the most distal set of tentacles; the "hydrotheca" (Huxley) is the cup-like receptacle into which the polypites are retractile in the Campanularian and Sertularian Hydroids; the "gonophore" is the proper generative bud, either in the form of a sac or of a locomotive Medusa, upon which devolves the function of giving origin directly or indirectly to the generative elements; the "gonangium" is the capsule or receptacle in which the gonophores are contained in the Campanularian and Sertularian Hydroids; the "gonoblastidium" (Huxley) is a more or less developed column which exists in certain Hydroids, and is destined to give origin to the gonophores, which are produced as buds from its sides; "adelocodonic" gonophores are those which are constructed on the plan of the "sporosac"—that is, in which the umbrella is never developed so as to present a wide orifice or "codonostome," and never becomes capable of acting as a locomotive organ; "phanerocodonic" gonophores are those which present the type of the developed Medusa in which the umbrella presents a wide orifice, and may in almost every case act as an organ of locomotion.

I.

*Synopsis of the Genera and Species of Tubularian Hydroids
whose trophosomes are known.*

Clavids.

1. CLAVA, Gmelin.

Trophosome.—Cœnosarc consisting mainly of a filiform hydrorhiza entirely invested by a chitinous periderm; hydrocaulus rudimental, and consisting of very short, simple, tubular processes from the free surface of the hydrorhiza, invested, like the hydrorhiza, by a periderm, and carrying the polypites on their summit. Polypites claviform, with scattered filiform tentacula.

Gonosome.—Gonophores adelocodonic, sessile or on very short peduncles, borne on the body of the polypite at the proximal side of the tentacles.

Clava multicornis, Forskal (sp.), = *Hydra multicornis*, Forskal.

Clava repens, Wright, = *Clava discreta*, Allm.

Clava leptostyla, Agass.

Clava diffusa, Allm.

Clava cornea, Wright.

Clava membranacea, Wright.

Clava nodosa, Wright.

Though the three species, *C. cornea*, *C. membranacea*, and *C. nodosa* are described as Scottish, I have not seen any specimens of them, and I here give them on the authority of Dr. Wright.

2. TUBICLAVA, Allman.

Trophosome.—Cœnosarc consisting of a well-developed hydrocaulus in the form of simple or branched stems, which are given off at intervals from a creeping filiform hydrorhiza, the whole invested by a chitinous periderm. Polypites borne on the summit of the hydrocaulus, claviform, with scattered filiform tentacula.

Gonosome.—Gonophores adelocodonic, consisting of clusters of sporosacs on the body of the polypite at the proximal side of the tentacula.

From the above definition the *Tubiclava cornucopia* of Norman * is excluded, this Hydroid being, in my opinion, the type of a new genus, which is distinguished from *Tubiclava* by having its gonophores borne on distinct gonoblastidia, and which, I believe, Mr. Norman will himself shortly characterize.

Tubiclava lucerna, Allm.

3. CAMPANICLAVA†, Allman, nov. gen.

Trophosome.—Cœnosarc a creeping, filiform, ramified hydrorhiza invested by a periderm; hydrocaulus undeveloped. Polypites sessile on the hydrorhiza, claviform, with scattered filiform tentacula.

Gonosome.—Gonophores phanerocodonic, sessile on the creeping hydrorhiza. Umbrella at the time of its liberation deep bell-shaped; manubrium simple-mouthed, shorter than the height of the bell-cavity; radiating canals four; marginal tentacles two, continuous with two opposite radiating canals, and having bulbous bases without distinct ocellus; two intervening smaller bulbs corresponding to the termination of the other two radiating canals in the circular canal.

There can be no doubt that the Medusa here described undergoes further changes before arriving at maturity. It is, at least, almost certain that two additional marginal tentacles become developed,

* See Norman in Ann. and Mag. Nat. Hist. Jan. 1864.

† *Campana*, a bell, and *Clava*, the name of a genus of Hydroids.

one from each of the intermediate bulbs, as the observations of Gegenbaur on this Hydroid go to prove.

Campaniclavula Cleodora, Gegenb. (sp.), = *Syncoryne Cleodora*, Gegenb.

4. TURRIS, Lesson.

Trophosome.—Cœnosarc invested by a periderm, and consisting of a creeping filiform hydrorhiza, with a rudimental hydrocaulus, which forms very short tubular processes supported on the free surface of the hydrorhiza, and carrying the polypites on their summits. Polypites claviform, with scattered filiform tentacula.

Gonosome.—Gonophores phanerocodonic. The mature Medusa has a subcylindrical umbrella, with four or eight longitudinal bands; manubrium massive, with a four-lipped mouth; radiating canals four; marginal tentacles numerous, each with a bulbous base having a distinct ocellus.

The trophosome of *Turris* was discovered by Gosse, who traced its development from the eggs of *Turris neglecta*, Forbes. It was afterwards observed by Dr. Strethill Wright, who carried its development still further, and named it *Clavula Gossii*.

We do not yet know anything as to the part of the trophosome from which the gonophores are developed, nor of the condition of the Medusæ at the time of their liberation.

Turris neglecta, Forbes. Trophosome = *Clavula Gossii*, Wright.

5. CORDYLOPHORA, Allman.

Trophosome.—Cœnosarc a creeping filiform hydrorhiza supporting a well-developed branching hydrocaulus, the whole invested by a chitinous periderm. Polypites fusiform, developed from the extremities of the branches; tentacula filiform, scattered on the body of the polypite.

Gonosome.—Gonophores adelocodonic, borne on the hydrocaulus, never on the polypite.

Cordylophora lacustris, Allm.

Cordylophora albicola, Kirchenpauer.

6. CORYDENDRIUM, Van Beneden.

Trophosome.—Cœnosarc consisting of a rooted and branching hydrocaulus invested by a periderm. Polypites developed from the extremities of the branches, fusiform, with scattered filiform tentacula.

Gonosome.—Gonophores phanerocodonic, developed from the cœnosarc. Form of Medusa unknown.

Corydendrium parasiticum, Van Ben., = *Syncoryne parasitica*, Ehrenb., = *Sertularia parasitica*, Cavolini.

Podocorynidae.

1. STYLACTIS*, Allman, nov. gen.

Trophosome.—Cœnosarc mainly composed of a retiform hydrorhiza, which consists of anastomosing tubes invested by a periderm; hydrocaulus rudimental (or absent?). Polypites claviform, with a single verticil of filiform tentacles surrounding the base of a conical metastome.

Gonosome.—Gonophores adelocodonic, borne on the body of the polypite at the proximal side of the tentacles.

Stylactis fucicola, Sars (sp.), = *Podocoryne fucicola*, Sars.

Stylactis Sarsii, Allm., = *Podocoryne carnea*, Sars.

I have given the name of *S. Sarsii* to a Hydroid which Sars regarded as a form of his *Podocoryne carnea* with sporosacs instead of Medusæ (Fauna Lit. Norv. p. 7, pl. 2. fig. 5). It is, however, no form of *Podocoryne carnea*, and must be withdrawn even from the genus.

2. PODOCORYNE, Sars (in part).

Trophosome.—Cœnosarc invested by a periderm, and composed of a creeping retiform hydrorhiza, with a rudimental hydrocaulus consisting of very short, simple, tubular processes from the free surface of the hydrorhiza, and having the polypites developed from their extremities. Polypites with a single verticil of filiform tentacula placed round the base of a conical metastome.

Gonosome.—Gonophores phanerocodonic, borne on the body of the polypite at the proximal side of the tentacles†. Medusa with a deep bell-shaped umbrella, a small four-lipped manubrium, four radiating canals, and eight marginal tentacles, with bulbous bases, but destitute of ocelli.

Podocoryne carnea, Sars.

Podocoryne (?) *aculeata*, Wagner (sp.), = *Coryne aculeata*, Wag.

3. CORYNOPSIS ‡, Allman, nov. gen.

Trophosome.—Hydrorhiza ramified and creeping; hydrocaulus rudimental or absent. Polypites claviform, with a single verticil of filiform tentacula surrounding the base of a conical metastome.

Gonosome.—Gonophores phanerocodonic, borne on the body of the polypite at the proximal side of the tentacular verticil.

* From *στυλος*, a column, and *ἀκρίς*, a ray.

† In every known instance the polypites which carry gonophores in the genus *Podocoryne* are more or less arrested in their development, apparently by the exhaustion caused by their burden; but they never present the condition of true gonoblastidia.

‡ From *κορυφή*, a club, and *ὄψις*, face (resemblance).

Medusa at the time of liberation deep bell-shaped; manubrium not reaching the orifice of the bell, and having its mouth surrounded by four short tentacles; radiating canals four, each terminating distally in a bulb, from which are developed two tentacles, each with a distinct ocellus at its base.

Corynopsis Alderi, Hodge (sp.), = *Podocoryne Alderi*, Hodge.

The genus *Corynopsis* has been constituted for the *Podocoryne Alderi* of Mr. Hodge—a Hydroid, however, whose gonosome will at once separate it from the true *Podocoryne*. It will be noticed that the Medusa, at the time of its liberation, is not to be distinguished from that of *Bougainvillia* at the same stage of its development. The further progress of the Medusa of *Corynopsis* has not been traced; but it is highly probable that we have here a true case of isogonism with *Bougainvillia*.

4. DIPLURA, Greene, MS.

Trophosome.—Polypite supported on the summit of a simple hydrocaulus, with a branched and creeping (?) hydrorhiza; periderm?; tentacles filiform, in a single verticil (?) near the distal extremity of the body.

Gonosome.—Gonophores phanerocodonic, on simple peduncles, which arise in a verticil from the body of the polypite at the proximal side of the tentacles. Medusa deep bell-shaped, with moderate-sized manubrium; radiating canals four, each terminating in a bulbous expansion at the point of intersection with the circular canal: from one of these marginal bulbs two long tentacles are developed; the rest of the margin is destitute of tentacles.

The genus *Diplura* was originally, under the name of *Diplonema*, established by Prof. J. Reay Greene for a Hydroid of which the Medusa was alone known to him. (Nat. Hist. Rev. 1857, vol. iv.). The name of *Diplonema*, however, happened to be preoccupied by the botanist, and Prof. Greene has since substituted for it that of *Diplura*. The Medusa thus named he found free in the open sea near Dublin; and it is undoubtedly congeneric with that described by Steenstrup as the Medusa of a Hydroid trophosome, which he names *Coryne fritillaria*. Steenstrup's Hydroid, however, is certainly not a *Coryne* in the sense in which we must now understand this genus; and though his description and figure are insufficient for an entirely satisfactory diagnosis, they compel us to regard his Hydroid as the representative of a distinct generic type, to which the name proposed by Prof. Greene for the Medusa, whose relation to Steenstrup's form he recognized at the time of its discovery, must now be given.

Agassiz refers it to *Steenstrupia* (Contr. Nat. Hist. U. S. vol. iv.); but the genus *Steenstrupia* was founded by Forbes for a Medusa of an entirely different type, though possessing unmistakable affinities with *Diplura*.

Hydractinidæ.

1. HYDRACTINIA, Van Beneden.

Trophosome.—Cœnosarc forming a continuous expansion whose free surface is destitute of periderm, but whose deeper parts consist of an areolar mass of freely intercommunicating tubes, which are each invested by a distinct periderm, and are adnate to one another. Polypites claviform, developed at intervals from the free naked surface of the cœnosarc; tentacles filiform, approximated into a single verticil round the base of a very contractile and mutable metastome.

Gonosome.—Sporosacs supported on gonoblastidia, which arise, like the polypites, from the naked free surface of the cœnosarc, are destitute of tentacles, and terminated by spherical clusters of thread-cells.

Hydractinia echinata, Flem. (sp.), ♂, = *Hydractinia lactea*, Van Ben., ♀, = *Hydractinia rosea*, Van Ben., = *Synhydra parasites*, Quatref., = ? *Dysmorphosa conchicola*, Philippi.

Hydractinea polyclina, Agass.

2. RHIZOCLINE*, Allman, nov. gen.

Trophosome.—Cœnosarc forming an adherent stratum supported by "a solid chitinous expansion"†. Polypites developed at intervals from the free surface of the cœnosarc; tentacles filiform, in a single verticil round the base of a conical metastome.

Gonosome.—Gonophores phanerocodonic, sessile on the free surface of the cœnosarc. Umbrella, at the time of liberation, deep bell-shaped; manubrium large, with a four-lipped mouth, but not extending beyond the margin of the umbrella; four radiating canals continued distally by four marginal tentacles with bulbous bases; three shorter tentacles developed in each interradiial space.

Rhizocline areolata, Alder (sp.), = *Hydractinia areolata*, Alder.

Laridæ.

1. LAR, Gosse.

Trophosome.—Cœnosarc a creeping, filiform, and anastomosing hydrorhiza, on which sessile polypites are developed at intervals;

* From *ρίζα*, a root, and *κλίνη*, a bed.

† Mr. Alder describes the attached base of the Hydroid for which I have found it necessary to constitute the present genus as "consisting of a solid chitinous expansion, from which arise simple linear spines in regular groups having areolar spaces between them." There can be no doubt, however, that, with specimens favourable for observation, he would have discovered a fleshy cœnosarc in connexion with the chitinous basis.

periderm (?). Polypites fusiform, with two tentacula situated at the base of a two-lipped metastome.

Gonosome not known.

The remarkable and aberrant form described by Gosse under the name of *Lar Sabellarum* will need further investigation before it will be possible to determine its true affinities. I have retained it here, however, as a legitimate genus, and the type of a distinct family, though, with our present knowledge of it, we are almost tempted to regard it as an abnormal condition of some other form.

Lar sabellarum, Gosse.

Corynidae.

1. CORYNE, Gärtner.

Trophosome.—Cœnosarc consisting of a simple or branching hydrocaulus rooted by a creeping filiform hydrorhiza, the whole invested by a chitinous periderm. Polypites developed from the summits of the hydrocaulus, clavate; tentacles capitate, scattered on the body of the polypite.

Gonosome.—Gonophores adelocodonic, developed from the body of the polypite.

Coryne pusilla, Gärt., = *Coryne pusilla*, Johnst., nec Van Beneden.

Coryne ramosa, Sars.

Coryne fruticosa, Hincks.

Coryne vaginata, Hincks, = *Coryne ramosa*, Johnst., = *Coryne*, sp., Lister.

Doubtful species.

Coryne sessilis, Gosse.

2. SYNCORYNE, Ehrenberg (in part).

Trophosome.—Cœnosarc composed of a simple or branching hydrocaulus rooted by a creeping filiform hydrorhiza, and the whole invested by a chitinous periderm. Polypites claviform, developed from the summits of the hydrocaulus; tentacles capitate, scattered upon the body of the polypite.

Gonosome.—Gonophores phanerocodonic, developed upon the body of the polypite. Umbrella, at time of liberation, deep bell-shaped; manubrium moderately large, not reaching the mouth of the bell*, destitute of oral tentacles; radiating canals four; marginal tentacles four, with bulbous bases, generally furnished with an ocellus. In some cases the gonophores, though phane-

* It is to be kept in mind that the characters here given are those of the Medusa at the time when it becomes free; it is probable, however, that it ultimately assumes the type of *Sarsia*, with its greatly developed and extensile manubrium. See Agassiz on *Coryne mirabilis*, in the fourth vol. of Cont. Nat. Hist. U. S.

rocodonic, never become free, and the marginal tentacles then remain in an imperfectly developed state.

Syncoryne Sarsii, Lovén, = *Syncoryne decipiens*, Dujardin.

Syncoryne ramosa, Lovén.

Syncoryne (sp.), Désor.

Syncoryne turricula, M'Crary (sp.), = *Sarsia turricula*, M'Crary.

M'Crary figures and describes the Medusa of this species; but his description of the trophosome is not full enough for a satisfactory diagnosis.

Syncoryne mirabilis, Agass. (sp.), = *Coryne mirabilis*, Agass.

Syncoryne eximia, Allm. (sp.), = *Coryne eximia*, Allm. in Ann. Nat. Hist. 1859.

Syncoryne gravata, Wright (sp.), = *Coryne gravata*, Wright.

Provisional and Doubtful Species.

Syncoryne bryoides, Ehr., = *Tubularia muscoides*, Linn.

Syncoryne Listeri, Van Ben.

3. ZANCLEA, Gegenbaur.

Trophosome.—Cœnosarc consisting of a simple or branching hydrocaulus rooted by a filiform anastomosing hydrorhiza, the whole invested by a periderm. Polypites claviform, developed from the summits of the hydrocaulus; tentacles capitate, scattered over the body of the polypite.

Gonosome.—Gonophores phanerocodonic, developed from the body of the polypite. Medusa, at the time of its liberation from the trophosome, nearly spherical; manubrium simple-mouthed, not reaching the margin of the umbrella; radiating canals four; marginal tentacles two, developed from the distal extremities of two opposite radiating canals; two intermediate bulbous dilations at the intersections of the two other radiating canals with the circular canal; the tentacles commence with a large bulbous dilatation destitute of distinct ocellus, and are for the remainder of their extent closely set along their external sides with pedunculated sacs filled with thread-cells; from the bases of the tentacula and intermediate bulbs a cœcal claviform tube filled with thread-cells extends in the walls of the umbrella near its external surface and parallel to the corresponding radiating canal.

It is almost certain that the Medusa here described is destined to undergo considerable change before reaching its adult state, when its characters will, in all probability, be those assigned by Gegenbaur to his genus *Zanclea*. A Medusa captured by M'Crary in the open sea, and regarded by him (*Gymnophthalmata* of Charleston Harbour) as a young state of a species of *Zanclea*, is almost identical with that just described.

Zanclea implexa, Alder (sp.), = *Coryne implexa*, Alder, = *Coryne Briareus*, Allman, in Ann. Nat. Hist. 1859.

4. CORYNITIS, M'Crary.

Trophosome.—Polypites springing from an adherent base*; tentacles capitate, scattered over the body of the polypite†.

Gonosome.—Gonophores phaneroecodonic, borne upon the body of the polypite. Umbrella deep bell-shaped, thick-walled, with clusters of thread-cells imbedded in its walls, and with the roof of its cavity rising in four overarched spaces between the radiating canals; manubrium massive; radiating canals four; marginal tentacles four, club-shaped, with basal bulbs, each furnished with an ocellus.

Corynitis Agassizi, M'Crary †.

5. CANDELABRUM, De Blainville.

Trophosome.—Polypites clavate, springing from a tubular adherent hydrorhiza, which is invested by a periderm; tentacles wart-like, scattered over the body of the polypite.

Gonosome.—Gonophores adelocodonic (?), on gonoblastidia which are clustered round the base of the polypite.

Candelabrum is De Blainville's name for the *Lucernaria Phrygia* of Fabricius, which Agassiz has shown to be identical with the *Myriothela* of Sars, and to which he has accordingly restored the original name given by De Blainville.

Candelabrum Phrygia, Fabricius (sp.), = *Lucernaria Phrygia*, Fabricius.

Candelabrum arcticum, Sars (sp.), = *Myriothela arctica*, Sars.

Pennaridæ.

1. VORTICLAVA, Alder.

Trophosome.—Polypites solitary, borne on the summit of a simple hydrocaulus, which is attached by a simple conical (?) hydrorhiza; periderm a delicate transparent film investing the hydrocaulus and the hydrorhiza; tentacles in two verticils, those composing the proximal verticil long and filiform, those composing the distal verticil short and capitate.

Gonosome unknown.

Vorticlava humilis, Alder.

Vorticlava Proteus, Wright.

* The nature of this base has not been described: it is probably a tubular reticulated hydrorhiza invested by a periderm.

† The trophosome of this genus has been described and figured by Agassiz under the name of *Halocharis* (Cont. Nat. Hist. U. S. vol. iv. p. 239), but has been since (*op. cit.* p. 340) referred by him to the genus *Corynitis*.

‡ The *Halocharis* (*Corynitis*) *spiralis* of Agassiz, *op. cit.* p. 239, may constitute a second species of *Corynitis*; but there is no mention of its gonosome, and it is not clear whether Agassiz does or does not regard it as distinct from *Corynitis Agassizi*.

2. *ACHARADRIA*, Strethill Wright.

Trophosome.—Hydrocaulus branched, with a well-developed periderm; hydrorhiza (?). Polypites with two verticils of tentacula, those composing the proximal verticil long and filiform, those composing the distal verticil short and capitate.

Gonosome unknown.

Acharadria larynx, Wright.

3. *HETERACTIS**, Allman, nov. gen.

Trophosome.—Polypite solitary, borne on the summit of a simple rooted hydrocaulus; two verticils of tentacles, a proximal and a distal,—the tentacles composing the proximal verticil long and “annulated” (Sars), those composing the distal verticil short and capitate.

Gonosome.—Gonophores phanerocodonic, borne upon peduncles, which arise from the body of the polypite at the distal side of the proximal verticil of tentacles. Umbrella in the form of a shallow bell, with four radiating canals, one large marginal tentacle, and three rudimental ones.

The genus *Heteractis* is constructed for the *Corymorpha annulicornis* of Sars, which is certainly not a *Corymorpha*, as indeed Sars himself suspects; it may possibly belong to the genus *Forticlava*, Alder, as already suggested by Hincks; but, from our present knowledge of it, and the absence of all knowledge of the gonosome in *Forticlava*, we should hardly yet be justified in associating the two forms in a common genus.

Heteractis annulicornis, Sars (sp.), = *Corymorpha*? *annulicornis*, Sars.

4. *STAUROIDIUM*, Dujardin.

Trophosome.—Cœnosarc consisting of a branched or simple hydrocaulus arising from a creeping filiform hydrorhiza, the whole invested by a periderm. Polypites borne on the summits of the hydrocaulus, clavate, with two verticils of tentacles, each verticil consisting of four tentacles arranged in a cross; the tentacles of the proximal verticil filiform, those of the distal verticil capitate.

Gonosome.—Gonophores phanerocodonic, developed from the body of the polypite. Umbrella deep bell-shaped; manubrium not reaching the margin of the bell; mouth simple; radiating canals four; marginal tentacles four, nodulated with clusters of thread-cells, and with a distinct ocellus on the basal bulb†.

The name *Stauridium* is the same as “Stauridie” of Dujardin,

* From *ἑρεpos*, dissimilar, and *ἀκρίς*, a ray.

† Hincks has pointed out the identity in every respect of the gonophore of *Stauridium productum* with that of *Coryne* (*Syncoryne*) *eximia*.

only with its termination altered so as to adapt it to the ordinary form of zoological nomenclature—a form in which Dujardin's name has been used by most subsequent writers, as Krohn (Müller's Arch. 1853) and Gegenbaur (Zeit. f. w. Z. 1857, p. 230).

Dujardin and the writers who have followed him have given this name to a Hydroid whose trophosome is distinguished by the characters here enumerated; but as it has been shown by Hincks (Ann. Nat. Hist. Dec. 1862) that this form of trophosome may have two very different forms of gonosome, it is necessary to break up Dujardin's genus into two, one of which may retain his original name for the trophosome, while to the other we may give the name of *Cladonema*, that employed by Dujardin for the only form of Medusa which he succeeded in tracing to a Stauridioid trophosome.

Stauridium productum, Wright.

5. CLADONEMA, Dujardin.

Trophosome.—Cœnosarc consisting of a branching or simple hydrocaulus arising from a creeping filiform hydrorhiza, the whole invested by a chitinous periderm. Polypites borne on the summits of the hydrocaulus, clavate, with two verticils of tentacles, each verticil consisting of four tentacles disposed in a cross, —the tentacles of the proximal verticil filiform, those of the distal verticil capitate*.

Gonosome.—Gonophores phanerocodonic, developed from the body of the polypite. Umbrella deep bell-shaped; manubrium large, with simple mouth; radiating canals eight, each continued at the margin of the umbrella into a branching tentacle with a bulbous base provided with an ocellus.

Cladonema radiatum, Dujardin.

6. PENNARIA, Goldfuss.

Trophosome.—Cœnosarc composed of a symmetrically ramified hydrocaulus, rooted by a creeping filiform hydrorhiza, the whole invested by a chitinous periderm. Polypites borne on the summits of the branches, oviform, with two sets of tentacles—a proximal set filiform and arranged in a single verticil round the base of the polypite, and a distal set capitate and scattered on the body of the polypite.

Gonosome.—Gonophores phanerocodonic, developed between the proximal and distal set of tentacles. Umbrella deeply ovate; manubrium large, but not passing beyond the orifice of the

* It will be noticed that the above description of the trophosome of *Cladonema* is identical with that of the trophosome of *Stauridium*. The differences between the two genera are confined to the gonosome, where they are well marked.

umbrella; radiating canals four; four rudimental, papilliform marginal tentacles*.

Pennaria distycha, Goldf., = *Pennaria Cavolini*, Ehrenb., = *Sertularia pennaria*, Cavolini.

Pennaria gibbosa, Agassiz.

7. GLOBICEPS, Ayres.

Trophosome.—Cœnosarc rooted, symmetrically branched, and invested by a chitinous periderm. Polypites claviform, with two sets of tentacles—a proximal set filiform and arranged in a single verticil round the base of the polypite, and a distal set capitate and arranged in one or more verticils, never scattered.

Gonosome.—Gonophores phanerocodonic, developed between the proximal and distal sets of tentacles. Umbrella deeply ovate, with large manubrium; four radiating canals, and four rudimental, papilliform marginal tentacula.

Globiceps tiarella, Ayres, = *Eucoryne elegans*, Leidy, = *Pennaria tiarella*, M'Crady.

Clavatellidæ.

1. CLAVATELLA, Hincks.

Trophosome.—Cœnosarc composed of a filiform branching hydrorhiza, with a hydrocaulus consisting of very short simple stems, which arise from the free surface of the hydrorhiza, the whole invested by a periderm. Polypites developed from the summit of the hydrocaulus, and having a single verticil of capitate tentacula surrounding the base of a conical metastome.

Gonosome.—Gonophores consisting of naked ambulatory Medusæ, which are developed in clusters from the polypite near its proximal extremity. Umbrella not extended into a bell or disc fitted for natation; marginal tentacles six, bifurcated, the outer branch of the bifurcation terminated by a capitulum of large thread-cells, the inner by a claviform enlargement which carries a suckorial disk of attachment; an ocellus at the root of each tentacle; no lithocysts.

Clavatella, though it comes very near to the *Eleutheria* of Quatrefages, is nevertheless generically distinct from it.

Clavatella prolifera, Hincks.

* Agassiz describes, but not without doubt, the generative elements as produced upon the radiating canals. I entirely participate in Agassiz's doubts on this point. From Cavolini's description, it is plain that in his species the generative elements were produced in the walls of the manubrium, as in all other known cases among the Tabularian hydroids,

Eudendridæ.**1. EUDENDRIUM, Ehrenberg (in part).**

Trophosome.—Cœnosarc consisting of a well-developed branching hydrocaulus, rooted by a creeping filiform hydrorhiza, the whole invested by a chitinous periderm. Polypites developed from the summits of the branches, vasiform or oval, with the metastome contracted at its proximal and expanded at its distal extremity so as to be more or less trumpet-shaped; tentacles filiform, in a single verticil just behind the metastome.

Gonosome.—Gonophores adelocodonic, developed from the body of the polypite at the proximal side of the tentacles, or from the hydrocaulus*; female sporosacs monothalamic; male sporosacs polythalamic.

Eudendrium ramosum, Linn. (sp.), = *Tubularia ramosa*, Linn., = Small ramified tubular Coralline, Ellis, = *Tubularia trichoides*, Pallas, = ? *Sertularia racemosa*, Cavolini, = *Eudendrium ramosum*, Ehrenb.

Eudendrium rameum, Pallas (sp.), = *Tubularia ramea*, Pallas, = *Eudendrium rameum*, Johnst.

Eudendrium capillare, Alder, = *Corymbogonium capillare*, Allm.

Eudendrium arbuscula, Wright.

Eudendrium insigne, Hincks.

Eudendrium humile, Allm.

Eudendrium dispar, Agass.

Eudendrium annulatum, Norman.

Eudendrium cingulatum†, Stimpson.

Eudendrium vaginatum, Allm.

Eudendrium pusillum, Sars.

2. ATRACTYLIS, Strethill Wright (in part).

Trophosome.—Cœnosarc consisting of a hydrocaulus in the form of simple funnel-shaped stems, which are developed at intervals from a creeping filiform hydrorhiza, the whole invested by a chitinous periderm. Polypites emerging from the summits of the hydrocaulus, into which they are retractile, fusiform, with filiform tentacula placed in a single verticil round the base of a conical metastome.

Gonosome.—Gonophores adelocodonic, carried on the sides of the hydrocaulus.

* The polypite occasionally, from the exhaustion consequent on the growth of the gonophores, becomes arrested, loses its tentacles, and is converted into a false gonoblastidium.

† Stimpson's short description of this species (*Marine Invertebrata of Grand Manan*), unaccompanied as it is by a figure, is hardly sufficient for a satisfactory diagnosis.

The genus *Atractylis*, as originally defined by Dr. T. Strehill Wright, was made to include all those forms of the older genus *Eudendrium* which are characterized by a fusiform shape of the polypite and a conical metastome, the greater number of the species moreover presenting a more or less complete retractility within the summit of the hydrocaulus, though nothing like a proper hydrotheca is ever developed.

Among the forms, however, which Dr. Wright has included under his genus *Atractylis* are more than one generic type. One of these types had already been characterized under the name of *Perigonimus* by Sars, who described both the trophosome and the gonosome; while another had, under the name of *Bougainvillia*, been long ago described by Lesson, who, however, was only acquainted with the Medusa. That the *Bougainvillia* of Lesson is the Medusa of a Hydroid form of which the *Eudendrium ramosum* of Van Beneden (= *Atractylis ramosa* of Wright) may be taken as the type, has been shown by Dalyell, and confirmed by Wright and others. To this Hydroid and its allied species the name of *Bougainvillia* must accordingly be restored; and indeed we find Agassiz already arranging them partly under Lesson's name, and partly under that of *Margelis*, Steenstrup's name for a Medusa which can scarcely be regarded as different from the *Bougainvillia* of Lesson. There thus remains only one form of Wright's genus *Atractylis* which had not already received a distinguishing generic designation,—that, namely, which is represented by the *Atractylis arenosa* of Alder, whose gonosome has been recently so well described by Dr. Wright (*Microscopical Journal*, n. s. vol. iii.). To this form, therefore, it will be necessary henceforth to restrict the name *Atractylis*.

Atractylis arenosa, Alder.

The following species cannot be regarded as otherwise than provisionally referred to the genus *Atractylis*. Two of them will probably turn out, when the gonophores shall have been observed, to belong really to the genus *Perigonimus*; while a third is undoubtedly the type of an entirely new genus.

Atractylis coccinea, Wright.

Atractylis miniata, Wright.

Atractylis margarica, Hincks.

The *Atractylis margarica* has been described by Mr. Hincks in the 'Ann. and Mag. of Nat. Hist.' for January 1863. It is certainly not an *Atractylis*, but is the type of an entirely new genus. I refrain, however, from giving here a definite form and name to the genus which I know must be constituted for it, preferring to leave this duty in the hands of its discoverer, Mr. Hincks, who, I have little doubt, will take the same view in his forthcoming work on the Hydroids.

3. BIMERIA, Strehill Wright.

Trophosome consisting of a branching rooted coenosarc in-

vested by a chitinous periderm. Polypites developed from the summits of the branches, "vase-shaped, destitute of proboscis" (metastome), and having the tentacles in a single verticil round the margin of the distal end of the vase-shaped body. "Coral-lum (periderm) body, mouth, and lower half of each of the tentacles clothed in an opaque brown membrane." (Dr. T. S. Wright.)

Gonosome.—Gonophores adelocodonic, developed from the *cœnosarc*.

Some years ago (Ann. Nat. Hist. July 1859) I constituted a genus, under the name of *Manicella*, for a singular Hydroid which I had discovered in the Firth of Forth. Simultaneously with the publication of *Manicella*, Dr. Strethill Wright published his genus *Bimeria* for a Hydroid which he had previously described and characterized as a new genus under this name at a meeting of the Royal Physical Society of Edinburgh, but of which no published account existed. On seeing Dr. Wright's description of his *Bimeria*, I was at first disposed to regard the two genera as identical, and to believe that we had been, independently and unknown to one another, describing the same form. Further consideration, however, of Dr. Wright's description of *Bimeria* has shown me that, besides differing in some minor points, this description is in one very important point quite inapplicable to *Manicella*; for while *Manicella* possesses a well-developed metastome, it is stated by Dr. Wright that there is no metastome in *Bimeria*.

I have had no opportunity of inspecting authentic specimens of Dr. Wright's Hydroid. It is quite possible that the metastome of *Bimeria* may have been overlooked; this question can be decided only by further examination. Until, however, the absence of a metastome in *Bimeria* be confirmed, I should hesitate to give *Manicella* the position of an established genus; and I shall therefore for the present retain it as entirely provisional.

Bimeria vestita, Wright.

4. GARVEIA, Strethill Wright.

Trophosome.—*Cœnosarc* invested by a periderm, and consisting of a branching hydrocaulus, which is rooted by a filiform hydrorhiza, and towards its base composed of aggregated tubes. Polypites fusiform, developed on the summits of the branches, and having the tentacles in a single verticil round the base of a long conical metastome.

Gonosome.—Gonophores adelocodonic, borne on the summits of short branches, which spring from the sides of the hydrocaulus.

Garveia nutans, Wright, = *Eudendrium* (*Corythamnium*) *bacciferum*, Allm.

5. HETEROCORDYLE*, Allman, nov. gen.

Trophosome.—Cœnosarc consisting of a simple or branched hydrocaulus, which arises from a creeping, filiform and anastomosing hydrorhiza, the whole invested by a chitinous periderm. Polypites fusiform, with a single verticil of filiform tentacula round the base of a conical metastome.

Gonosome.—Gonophores adelocodonic, borne by gonoblastidia, which are developed (solely ?) from the hydrorhiza ; sporosacs of the ordinary kind, destitute of tentacles and cilia, and incapable of locomotion.

Heterocordyle Conybearei, Allm.

6. PERIGONIMUS, Sars.

Trophosome.—Cœnosarc invested by a periderm, and consisting of a branching or simple hydrocaulus rooted by a filiform hydrorhiza. Polypites borne on the summits of the hydrocaulus, fusiform, with a single verticil of filiform tentacula, which surround the base of a conical metastome.

Gonosome.—Gonophores phanerocodonic, developed from the cœnosarc. Umbrella at the time of liberation deep bell-shaped, with a manubrium which is shorter than the height of the bell-cavity, and has a mouth which is simple or with four shallow lips ; radiating canals four ; marginal tentacles two or four, with bulbous bases, which are not furnished with distinct ocelli.

The changes which occur as the Medusa advances towards maturity are to be chiefly sought for in an increase in the number of marginal tentacles, the new tentacles being intercalated at the middle point between every two older ones.

Perigonimus muscoides, Sars.

Perigonimus repens, Wright (sp.), = *Atractylis repens*, Wright.

Perigonimus sessilis, Wright (sp.), = *Atractylis sessilis*, Wright.

Perigonimus palliatus, Wright (sp.), = *Atractylis palliata*, Wrgt.

Perigonimus? linearis, Alder (sp.), = *Atractylis linearis*, Alder †.

Perigonimus serpens, Allman.

Perigonimus minutus, Allman.

Perigonimus pusillus, Wright (sp.), = *Eudendrium pusillum*, Wright.

7. BOUGAINVILLIA, Lesson.

Trophosome.—Cœnosarc consisting of a branching hydro-

* From ἑρεpos, dissimilar, and κορδύλη, a club.

† It is with some doubt that I place this species in the genus *Perigonimus*, the Medusa having been apparently examined in imperfect specimens, and consequently not determinable with sufficient certainty from Mr. Alder's figure and description ; but it seems to come nearer to the type which is characteristic of *Perigonimus* than to anything else.

caulus rooted by a filiform hydrorhiza, the whole invested by a periderm. Polypites developed from the summits of the branches, fusiform, with a conical metastome; tentacles filiform, in a single verticil round the base of the metastome.

Gonosome.—Gonophores phanerocodonic, developed from the cœnosarc. Medusæ, at the time of liberation, with a deep bell-shaped umbrella; manubrium shorter than the height of the bell-cavity, with four oral tentacles; radiating canals four, each terminating, at its intersection with the circular canal, in a bulb, from which two tentacles are developed, each with an ocellus at its base.

Before attaining maturity, the oral tentacles become dichotomously branched, and the bulbs upon the margin of the umbrella carry each a fasciculus of numerous tentacles, every tentacle having an ocellus at its base.

Bougainvillia ramosa, Van Beneden (sp.), = *Eudendrium ramosum*, Van Ben., = *Tubularia ramosa*, Dalyell, = *Atractylis ramosa*, Wright, = *Margelis ramosa*, Agassiz.

Bougainvillia fruticosa, Allm.

Bougainvillia muscus, Allm.

Dicorynidae.

1. DICORYNE, Allman.

Trophosome.—Cœnosarc consisting of a branched or simple hydrocaulus, which arises from a creeping, filiform and anastomosing hydrorhiza, the whole invested by a periderm. Polypites fusiform, with a single verticil of tentacula surrounding the base of a conical metastome.

Gonosome.—Gonophores adelocodonic, developed upon gonoblastidia which are borne either upon the hydrocaulus or the hydrorhiza. Sporosacs natatory, ciliated over their whole surface, and having two filiform tentacula diverging from the proximal end.

Dicoryne conferta, Alder (sp.).

Tubularidae.

1. TUBULARIA, Linn. (in part).

Trophosome.—Cœnosarc invested by a chitinous periderm, and consisting of a simple or branched hydrocaulus rooted by a filiform hydrorhiza. Polypites flask-shaped; tentacles filiform, in two verticils, those composing the proximal verticil longer than those composing the distal; distal verticil surrounding the base of a conical metastome.

Gonosome.—Gonophores adelocodonic, developed upon ra-

cemiform peduncles, which spring from the body of the polypite between the proximal and distal verticil of tentacles.

The genus *Tubularia* of modern authors has been broken up by Agassiz into four separate genera, for one of which he retains the older name *Tubularia*, while he designates the three others respectively *Parypha*, *Thamnocnidia*, and *Ectopleura* (Cont. Nat. Hist. U. S. vol. iv.). He gives no technical diagnosis of any of these genera; but, from my own knowledge of the European species which he separates from *Tubularia*, as well as from the very detailed descriptions and beautiful figures of the American species which he now for the first time describes and refers to his new genera, I can find only in one of these forms (namely, the *Tubularia Dumortieri* of Van Beneden) characters which would, in my opinion, justify the proposed dismemberment. For *Tubularia Dumortieri* Agassiz constitutes a new genus under the name of *Ectopleura*, and in this I willingly follow him; but the only character of importance by which *Parypha* and *Thamnocnidia* are separated from *Tubularia* is the non-development of gastro-vascular canals in the sporosacs of the species referred by Agassiz to these genera, while they are found in the sporosac of *Tubularia indivisa*.

Now I cannot admit that the presence or absence of these canals in a sporosac, so long as they do not bring with them the development of an open contractile umbrella capable, when detached, of acting as a swimming-organ, can be regarded as affording a character of generic value, even though we leave out of view the great difficulty of detecting it, which is a practical rather than a scientific objection.

Again, between *Parypha* and *Thamnocnidia* the only difference alleged is in the structure of the tentacula-like tubercles which occur upon the summit of the sporosac. I believe, however, that there is here no important difference. I have carefully examined the sporosacs of *Tubularia coronata*, Abildg., a species which Agassiz refers to his genus *Thamnocnidia*, and I can find no essential difference between the tentacular tubercles which crown the sporosac in this species and those described by Agassiz as characteristic of his genus *Parypha*.

Tubularia indivisa, Linn., = *Tubularia calamaris*, Pallas.

Tubularia Couthoyi, Agass.

Tubularia coronata, Abildg., = ? *Tubularia gracilis*, Harvey, = *Thamnocnidia coronata*, Agass.

Tubularia spectabilis, Agass. (sp.), = *Thamnocnidia spectabilis*, Agass.

Tubularia tenella, Agass. (sp.), = *Thamnocnidia tenella*, Agass.

Tubularia cristata, M'Crad., = *Parypha cristata*, Agass.

Tubularia crocea, Agass. (sp.), = *Parypha crocea*, Agass.

Tubularia bellis, Allm.

Tubularia attenuata, Allm.

Tubularia larynx, Ellis & Soland.

Tubularia simplex, Alder.

? *Tubularia calamaris*, Van Ben.

2. ECTOPLEURA, Agassiz.

Trophosome.—Cœnosarc invested by a chitinous periderm, and consisting of a simple or branched hydrocaulus springing from a filiform (?) hydrorhiza. Polypites flask-shaped, with filiform tentacula arranged in two verticils, the proximal verticil composed of tentacles which are longer than those forming the distal verticil.

Gonosome.—Gonophores phanerocodonic, on branched peduncles, which are borne upon the body of the polypite, between the proximal and distal verticils of tentacles. Medusa, at the time of liberation, with a nearly spherical umbrella; a manubrium with a simple mouth, and shorter than the height of the umbrella-cavity; four radiating canals, and four marginal tentacles; no distinct ocelli; the umbrella furnished with eight prominent longitudinal ribs formed of linear series of thread-cells.

To his genus *Ectopleura* Agassiz, as has been already said, refers the *Tubularia Dumortieri* of Van Beneden. In thus separating Van Beneden's Tubularidan from the true *Tubulariæ*, Agassiz seems to me to be fully justified; but I cannot so easily assent to the correctness of associating with it in the same genus the *Sarsia pulchella* of Forbes, the *Sarsia turricula* of M'Crady, and the *Sarsia nodosa* of Busch. (See Contr. Nat. Hist. U. S. vol. iv. p. 343.) These naked-eyed Medusæ are very different from the Medusæ of Van Beneden's *Tubularia Dumortieri*, while one of them (*Sarsia turricula*) has been traced by M'Crady, if not with absolute certainty, at least with high probability, to a Coryniform trophosome.

Ectopleura Dumortieri, Van Ben. (sp.), = *Tubularia Dumortieri*, Van Ben.

3. HYBOCODON, Agassiz.

Trophosome.—Cœnosarc invested by a chitinous periderm, and consisting of a simple (or branched?) hydrocaulus rooted by a filiform hydrorhiza. Polypites flask-shaped, with the tentacles arranged in two sets,—the proximal set long, and forming a single verticil, the distal short, and arranged in two verticils.

Gonosome.—Gonophores phanerocodonic, springing directly from the body of the polypite between the proximal and distal sets of tentacles*. Medusa, at the time of liberation, with a deep-belled umbrella, a moderate-sized, simple-mouthed manubrium, four radiating canals, and with the distal extremity of

* In *Hybocodon prolifer*, the only described species, "the first Medusa arises directly from the actinal area of the disc, while from the marginal termination of one of the radiating tubes of this Medusa numerous similar Medusæ are developed, the latter again giving rise to other Medusæ in the same manner, and from a corresponding place on their margin." (Agassiz.)

one of the canals prolonged into a single marginal tentacle with a bulbous base, but without distinct ocellus.

Hybocodon prolifer, Agass.

4. CORYMORPHA, Sars (in part).

Trophosome.—Polypite solitary, borne on the summit of a simple hydrocaulus, which terminates proximally in a conical hydrorhiza; both hydrocaulus and hydrorhiza invested by a very delicate, transparent, filmy periderm. Polypites flask-shaped, with two sets of filiform tentacles, a proximal and a distal, the proximal imperfectly contractile, longer and thicker than the distal, and arranged in a single verticil near the base of the polypite; the distal set very contractile, forming several closely placed, alternate, more or less perfect verticils behind a conical metastome.

Gonosome.—Gonophores phaneroconic, borne on branched peduncles, which spring from the body of the polypite at the distal side of the proximal set of tentacles. The Medusa, at the time of its liberation, has a deep-belled umbrella, a well-developed simple-mouthed manubrium, four radiating canals, and a single marginal tentacle; each of the radiating canals terminates, at its junction with the circular canal, in a bulbous expansion without distinct ocellus: one of these bulbs is larger than the other, and from this alone the solitary tentacle is developed.

Judging from *Corymorpha nutans*, it would seem that the further changes undergone by the Medusa before arriving at maturity are of little importance: it is especially to be noticed that the marginal tentacle always remains solitary.

Corymorpha nutans, Sars.

Corymorpha nana, Alder.

5. AMALTHEA, O. Schmidt.

Trophosome.—Polypites solitary, with two sets of filiform tentacles, a proximal and a distal,—the proximal set very long and placed in a single verticil, the distal set very short, numerous, and scattered.

Gonosome.—Gonophores phaneroconic, borne upon peduncles which arise between the proximal and distal sets of tentacles. Medusæ with a deep bell-shaped umbrella, four radiating canals, and four equal marginal tentacles with bulbous bases.

Amalthea uvifera, O. Schmidt, = *Corymorpha uvifera*, Sars.

Amalthea Sarsii, Steenstrup (sp.), = *Corymorpha Sarsii*, Steenstrup.

Amalthea Januarii, Steenstrup (sp.), = *Corymorpha Januarii*, Steenstrup.

6. MONOCAULOS*, Allman, nov. gen.

Trophosome.—Polypite solitary, borne on the summit of a simple rooted hydrocaulus; both hydrocaulus and hydrorhiza invested by a very delicate periderm; polypites flask-shaped, with two sets of filiform tentacles,—a proximal set longer and thicker, and arranged in a single verticil near the base of the polypite, and a distal set shorter and thinner, and scattered over a zone close to the summit of the polypite.

Gonosome.—Gonophores adelocodonic, on simple or branched peduncles, which spring from the body of the polypite at the distal side of the longer tentacles.

Monocaulos glacialis, Sars (sp.), = *Corymorpha glacialis*, Sars.

Monocaulos pendula, Agass. (sp.), = *Corymorpha pendula*, Agass.

7. NEMOPSIS, Agassiz.

Trophosome.—Polypite free, conical, with two verticils of filiform tentacula—a proximal near the base, and a distal near the apex; periderm absent.

Gonosome.—Gonophores phanerocodonic, on short simple peduncles which spring from the body of the polypite between the two verticils of tentacula. Umbrella deep bell-shaped; manubrium of moderate size, and furnished with four dichotomously branched oral tentacles; radiating canals four, each terminating in a marginal bulb, while from every marginal bulb a tuft of tentacles is given off, two of the tentacles in each tuft being clavate and but slightly contractile, the rest filiform and very contractile, every tentacle carrying a distinct ocellus at its base. The generative elements are developed in four lobes, which spring from the base of the manubrium and thence extend for some distance along the course of the radiating canals.

Nemopsis Gibbsii, M'Crary.

8. ACAULIS, Stimpson.

Trophosome.—The entire trophosome consists of a solitary, free, subfusiform polypite, which, at a later period, becomes attached by its proximal extremity; tentacles of two kinds,—one filiform, forming a single verticil near the proximal extremity, and subsequently disappearing—the other, capitate, and scattered on the body of the polypite towards its distal extremity; periderm absent.

Gonosome.—Gonophores phanerocodonic, springing from the body of the polypite between the filiform and capitate tentacula. Form of the Medusa unknown.

Acaulis primarius, Stimpson.

* From *μόνος*, single, and *καυλός*, a stalk.

II.

*Synopsis of the Genera and Species of Campanularian Hydroids with known trophosomes.***Campanularidæ.**

1. CAMPANULARIA, Lamarck (in part).

Trophosome.—Hydrocaulus simple or branching, rooted by a creeping filiform hydrorhiza; hydrothecæ bell-shaped, with an entire or serrated margin, and destitute of an operculum; tentacles surrounding the base of a large, very contractile metastome.

Gonosome.—Gonangium seated either on the hydrorhiza or hydrocaulus, and containing phaneroconic gonophores. Umbrella, at the time of liberation, deep bell-shaped; manubrium of moderate size, with the mouth provided with four shallow lips, or simple; radiating canals four; marginal tentacles four, with bulbous bases, destitute of ocelli; lithocysts eight, two in each interradial space, and never developed upon the base of a tentacle; generative elements developed in special sporosacs, which are borne as buds on the radiating canals.

As the Medusa advances towards maturity, the marginal tentacles increase in number, and the oral lobes of the manubrium become more decided.

The name of *Campanularia* was originally applied by Lamarck to certain Hydroids which had been a short time previously distributed by Lamouroux under two generic names, *Clytia* and *Laomedæa*. The genera *Clytia* and *Laomedæa*, as defined by Lamouroux, were constructed on insufficient and imperfectly comprehended characters, and cannot stand; while, at the same time, Lamarck's genus *Campanularia* involves two distinct generic types. For one of these types the name of *Campanularia* ought to be retained, while for the other we may choose between *Clytia* and *Laomedæa* of Lamouroux. *Laomedæa*, however, has been in more general use among authors, and it will therefore be convenient to retain it; while *Clytia*, which includes only forms referable to *Campanularia* or to *Laomedæa*, must accordingly be suppressed.

The Medusa of *Campanularia*, as this genus is here defined, is referable to a part of Gegenbaur's genus *Eucepe*. The Medusæ included by Gegenbaur under this name belong to two distinct types,—one distinguished, in its mature state, by its deep bell-shaped umbrella, its comparatively small number of marginal tentacles, and the position of the lithocysts in the centre of the interval between two tentacula; the other by its shallow, almost disc-shaped umbrella, its very numerous tentacula, with reentrant bases, and the position of the lithocysts—each on the inner side of the base of a tentacle. This latter group comprises the forms to which Péron and Lesueur had long ago given the name of *Obelia*; while, if *Eucepe* be retained as a generic appellation, it must be confined to the former.

Campanularia Johnstoni, Alder (sp.), = *Campanularia volubilis*, Johnst., = *Clytia Johnstoni*, Agass.

Campanularia noliformis, M'Crary (sp.), = *Clytia noliformis*, Agass.

Campanularia cylindrica, Agass. (sp.), = *Platypyxis cylindrica*, Agass.

Campanularia Gegenbaurii, Sars.

Campanularia dichotoma, Kölliker.

The following species are placed provisionally in this genus, the gonophores not having yet been observed in any of them. Further research will doubtless cause their distribution among two or more genera:—

Campanularia volubilis, Linn.

Campanularia verticillata, Linn.

Campanularia Hincksii, Alder.

Campanularia integra, Macgillivray.

*Campanularia raridentata**, Alder.

Campanularia breviscyphia, Sars.

Campanularia bicophora, Agass. (sp.), = *Clytia bicophora*, Agass.

2. OBELIA, Péron & Lesueur.

Trophosome.—Hydrocaulus branching, rooted by a creeping filiform hydrorhiza; hydrothecæ bell-shaped, with an entire or serrated margin, and destitute of operculum; tentacula surrounding the base of a very contractile, conical, clavate, or trumpet-shaped metastome.

Gonosome.—Gonangia developed from the hydrocaulus, and containing phaneroconic gonophores. Medusæ very flat, so as to approach the form of a disc, with a short four-lipped manubrium; radiating canals four; marginal tentacles numerous, with their roots prolonged in the form of short cæcal continuations into the walls of the umbrella; lithocysts two in each inter-radial space, each lithocyst placed upon the base of a tentacle at its inner side.

The changes undergone by the Medusa in its progress towards maturity consist chiefly in an increase in the number of marginal tentacula.

Obelia dichotoma, Linn. (sp.), = *Laomedea dichotoma*, var. *a*, Johnst., = *Campanularia gelatinosa*, Van Ben.

Obelia geniculata, Linn. (sp.), = *Laomedea geniculata*, Johnst.

Obelia commissuralis, M'Crary.

Obelia diaphana, Agass. (sp.), = *Eucope diaphana*, Agass.

* Judging from an observation of Wright (Mic. Journ. n. s. vol. ii.), it is quite possible that the *Campanularia raridentata* of Alder may belong to the genus *Thaumantias*. See below p. 377.

3. LAOMEDEA, Lamouroux (in part).

Trophosome.—Hydrocaulus simple or branched, rooted by a creeping filiform hydrorhiza; hydrothecæ bell-shaped, with the margin entire or serrated, but without an operculum; tentacular verticil surrounding the base of a very contractile, conical or trumpet-shaped metastome.

Gonosome.—Gonangia developed on the hydrorhiza or hydrocaulus, and containing adelocodonic gonophores, which never leave the cavity of the gonangium.

English authors generally include under *Laomedea* those species of *Campanulariæ* which are furnished with a branching hydrocaulus, while they refer to *Campanularia* those in which the hydrocaulus is simple. No generic distinction, however, can be based on this character—a character really unimportant, and frequently so little comprehensive that we may find the two conditions combined in the same species, thus rendering caution necessary in the employment of this character, even for the purposes of specific diagnosis.

It will be at once apparent from the diagnoses here given of *Campanularia*, *Obelia*, and *Laomedea*, that the differences in the gonosomes afford excellent characters by which we can distribute between three perfectly natural genera numerous forms of *Campanulariæ* which would otherwise defy our attempts at a satisfactory classification.

* Hydrocaulus mostly branched.

Laomedea flexuosa, Hincks (sp.), = *Laomedea gelatinosa*, var. *a*, Johnst.

Laomedea neglecta, Alder.

Laomedea angulata, Hincks.

Laomedea amphora, Agass.

Laomedea exigua, Sars.

Laomedea decipiens, Wright.

** Hydrocaulus mostly simple.

Laomedea volubiliformis, Sars (sp.), = *Campanularia volubiliformis*, Sars.

Laomedea poterium, Agass. (sp.), = *Clytia poterium*, Agass.

Laomedea caliculata, Hincks (sp.), = *Campanularia caliculata*, Hincks.

4. HINCKSIA, Agassiz.

Trophosome.—Hydrorhiza a creeping network of filiform tubes, from which a short simple hydrocaulus is emitted at intervals; hydrothecæ bell-shaped, destitute of operculum. Polypites?

Gonosome.—Gonangia borne on the hydrorhiza, and consisting of large, subcordate, pedunculated capsules with a small terminal aperture, transversely ribbed on one side, smooth on the other.

The genus *Hincksia* has been constituted by Agassiz for an Australian Hydroid described by Mr. Hincks from the dried periderm. Though there may be considerable doubt as to the justice of attributing a generic value to the characters assumed by Agassiz as the distinguishing mark of *Hincksia*, I have here retained the genus, with the expectation that the examination of the living Hydroid will confirm its title to a distinct generic rank.

Hincksia tinctoria, Agass. (gen.), = *Campanularia tinctoria*, Hincks.

5. GONOTHYRÆA*, Allman, nov. gen.

Trophosome.—Hydrocaulus branching, rooted by a filiform hydrorhiza; hydrotheca bell-shaped, with entire or serrated margin, and destitute of operculum; tentacula surrounding the base of a large, very contractile metastome.

Gonosome.—Gonophores adelocodonic. Sporosacs in the form of imperfect Medusæ (meconidia), carrying round the rudimental codonostome a circle of filiform tentacula, and, when mature, supported on the summit of the gonangium, where they lie entirely external to its cavity.

Gonothyraea Lovéni, Allm., = *Campanularia geniculata*, Lister, Lovén, Schultze, = *Laomedea Lovéni*, Allm.

Gonothyraea gracilis, Sars (sp.), = *Laomedea gracilis*, Sars.

6. TRICHYDRA, Strethill Wright.

Trophosome.—Hydrorhiza a branched and creeping thread, which sends off at intervals a rudimental hydrocaulus in the form of very short, tubular, cell-like processes, into which the polypites are retractile. Polypites very slender and cylindrical, carrying a single verticil of filiform tentacula round the base of a short conical metastome.

Gonosome unknown.

The genus *Trichydra* has been constituted by Dr. Wright for a Hydroid whose most important characters I have endeavoured to combine in the above diagnosis. I am by no means sure, however, of its being a well-established genus: it forcibly suggests the immature condition of some other form; and until its gonosome be discovered, we must continue to regard it as doubtful. It is true that Dr. Wright is of opinion that a Medusa of the type which we find in *Perigonimus*, and which he met with in a vase containing specimens of his *Trichydra*, may have been given off by this Hydroid; but it seems to me that the evidence is by no means in favour of this view, and indeed Dr. Wright does not himself insist upon it. It must be borne in mind that no trace of a gonosome was visible in any of the specimens; and I cannot avoid the belief that the Medusa found in the vase was accidentally present there. The great exten-

* From γένος, offspring, and θύραϊος, outside the door.

sibility of the polypites, and their power of complete retraction into hydrotheca-like receptacles, would seem to indicate that the affinities of *Trichydra* are rather with the Campanularian than with the Tubularian Hydroids.

Trichydra pudica, Wright.

7. CALYCELLA, Hincks.

Trophosome.—Hydrocaulus erect, and rooted by a filiform hydrorhiza, or creeping and adherent; hydrothecæ tubular or conical, and provided with an operculum which is formed of converging lanceolate segments. Polypites cylindrical, with the tentacular verticil surrounding the base of a conical metastome.

Gonosome.—Gonophores adelocodonic. Sporosacs of female ultimately delivering their contents into an acrocyst.

The genus *Calycella* was founded by Hincks (Ann. Nat. Hist. Oct. 1861) with the intention of including under it certain Hydroids previously placed under *Campanularia* and *Laomedea*. *Calycella*, however, as constructed by Hincks, really involves two distinct types, one of these being represented by *Calycella dumosa*, Hincks (gen.), and the other by *Calycella syringa*, Hincks (gen.).

Now the *C. dumosa* belongs to a form which had been already defined by Lamouroux under the name of *Lafoea*, a name, therefore, which the rule of priority obliges us to leave undisturbed; and the name of *Calycella* must accordingly be retained for the remaining type alone—that represented by the *Campanularia syringa* of authors, and by the *Campanularia lacerata* of Johnston.

Calycella syringa, Linn. (sp.), = *Campanularia syringa*, Lamk., = *Clytia syringa*, Lamx., = *Campanularia syringa*, Van Ben., = *Wrightia syringa*, Agass.

Calycella lacerata, Johnst. (sp.), = *Campanularia lacerata*, Johnst., = *Wrightia lacerata*, Agass.

Calycella? *humilis*, Hincks.

8. CAMPANULINA, Van Beneden.

Trophosome.—Hydrocaulus branching or simple, attached by a creeping filiform hydrorhiza; hydrothecæ with their margin continued by a delicate collapsible membrane [or else provided with a true operculum formed by converging lanceolate segments]. Polypites cylindrical; tentacula connected by a membranous web at their base.

Gonosome.—Gonophores phanerocodonic. Medusa, at the time of liberation, deep bell-shaped, with moderate-sized four-lipped manubrium; radiating canals four, each terminating distally in a non-ocellated bulb; marginal tentacles two, developed from two opposite bulbs [or four, every bulb then carrying a tentacle]; lithocysts eight, two in each interradial marginal space.

The genus *Campanulina* was constructed by Van Beneden (Bull. Ac. Roy. Brux. 1847) for a delicate Campanularian Hydroid whose most striking character appeared to the Belgian naturalist to be the broad membranous web by which the bases of the tentacles were united to one another. He named the Hydroid which he thus took as the type-species of the genus *Campanulina tenuis*.

Mr. Alder, from an examination of authentic specimens of Van Beneden's Hydroid, has since determined its identity with the species which had been described by himself under the name of *Laomedea acuminata*. As Van Beneden, however, has given us no definite specific diagnosis, while Alder has given us a very full and complete one, and as Alder's specific name has thereby become generally adopted, it will be more convenient to retain the name of *acuminata* rather than that of *tenuis*, and the rules of priority will hardly be so stringently interpreted as to offer any valid objection to this course.

In drawing up the diagnosis which I have given above for the genus *Campanulina*, I have deemed it better to make it sufficiently comprehensive to include *Campanulina repens*, Allm., a Hydroid discovered by myself, and which, with undoubted affinities to *Campanularia acuminata*, may possibly be regarded as presenting a separate generic form. It differs from *C. acuminata* in the fact of the hydrothecæ being provided with a true operculum formed of converging lanceolate segments, instead of having the undivided membranous termination which these receptacles exhibit in *C. acuminata*, and in the web which connects the bases of the tentacles being so slightly developed as to be nearly obsolete.

Besides this, the Medusa escapes from the gonangium with four well-developed marginal tentacles—a feature, however, which may only indicate a more advanced stage of development at the time of liberation, and not such as can be employed as a generic character, unless the difference in this respect between the two Medusæ can, by further observation, be shown to be permanent. I have recorded this Hydroid in my note-book under the generic name of *Hypsorophus* (*ὑψόροφος*, *high-roofed*), in allusion to the high conical operculum by which the hydrotheca is closed on the retreat of the polypite; but I prefer to keep this name as provisional, dependent on further observation proving that the difference between the Medusæ at the time of their liberation is persistent—a character which may then, when combined with the difference between the hydrothecæ, be regarded as truly generic.

Campanulina acuminata, Alder (sp.), = *Campanulina tenuis*, Van Ben., = *Laomedea acuminata*, Alder, = *Wrightia acuminata*, Agass.

Campanulina? repens, Allm.

Æquoridæ.

1. ZYGODACTYLA, Brandt.

Trophosome.—Hydrocaulus simple (or branched?), rooted by

a creeping filiform hydrorhiza; hydrothecæ with an operculum formed of converging lanceolate segments. Polypites cylindrical, with a verticil of filiform tentacula connected at their bases by a broad membranous web.

Gonosome.—Gonophores phanerocodonic. Medusæ with a broad, shallow umbrella and wide and short manubrium whose lips are prolonged into numerous arm-like lobes; radiating canals very numerous; marginal tentacles very numerous, radial and interradial, each developed from a bulbous base; margin of umbrella with lithocysts; generative elements developed along the course of the radiating canals.

We are indebted to Dr. T. S. Wright for the important observation by which he has shown that the ova of *Æquorea vitrina*, Gosse, become developed into polypoid trophosomes having the characters enumerated above. The *Æquorea vitrina* of Gosse, however, is not a true *Æquorea*, but, as Agassiz has pointed out, belongs rather to *Zygodactyla* of Brandt; and *Zygodactyla vitrina* thus becomes one of the few Hydroids in which the development of the trophosome from the ova of the free Medusa has been observed. The characters of the trophosome here given are those presented by this part of the Hydroid in the most advanced state to which it had been traced by Dr. Wright; but it must not be lost sight of, that it probably undergoes further changes before arriving at its completely developed condition.

Zygodactyla vitrina, Gosse (sp.) = *Æquorea vitrina*, Gosse.

Thaumantias.

1. THAUMANTIAS, Eschscholtz.

Trophosome.—Hydrocaulus rooted by a creeping filiform hydrorhiza; hydrothecæ destitute of an operculum. Polypites with the tentacular verticil surrounding the base of a trumpet-shaped metastome.

Gonosome.—Gonophores phanerocodonic. Mature Medusa with a hemispherical umbrella and short manubrium with lobed mouth-margin; radiating canals four; marginal tentacles numerous; lithocysts absent; generative sacs band-like along the course of the radiating canals*.

We are indebted to an observation of Dr. T. S. Wright for our knowledge of the trophosome of *Thaumantias*, Dr. Wright having seen developed from the ova of *Thaumantias inconspicua*, Forbes, a

* The genus *Thaumantias* is here defined in accordance with the limits assigned to it by Gegenbaur, who restricts it to such Medusæ as possess the characters given above. *Thaumantias* as thus limited will include the *T. inconspicua* of Forbes, so far as it is possible to judge from the description of this Medusa given in the "Monograph of the British Naked-eyed Medusæ."

minute polypoid trophosome, which he describes as bearing a close resemblance to the *Campanularia raridentata*, Alder. See Wright in Micr. Journ. n. s. vol. ii.

Thaumantias inconspicua, Forbes.

Leptoscyphidsæ.

1. LEPTOSCYPHUS*, Allman, nov. gen.

Trophosome.—Hydrocaulus simple or branching, attached by a creeping filiform hydrorhiza; hydrothecæ with an operculum composed of converging lanceolate segments. Polypites cylindrical when extended; tentacula surrounding the base of a conical metastome.

Gonosome.—Gonophores phanerocodonic. Umbrella, at the time of liberation, deep bell-shaped or conical; manubrium pendent from a conical projection from the roof of the umbrella, of moderate size, with the mouth surrounded by four short capitate tentacula; radiating canals four, each terminating distally in a bulb, without evident ocellus, each bulb giving origin to a cluster of two or three tentacles; a single marginal tentacle with a bulbous base is also developed from the centre of each interradial space.

I constitute the genus *Leptoscyphus* for a very minute Hydroid which I discovered some years ago in Orkney, where it occurs rather abundantly, creeping over the fronds of *Laminaria digitata*. I have already described it (Ann. Nat. Hist. Nov. 1859) under the name of *Laomedea tenuis*; but its remarkable Medusa, as well as the general characters of the trophosome, must certainly separate it from that genus. It will be noticed that the Medusa belongs to the type which is destitute of lithocysts, and has its generative elements developed in the walls of the manubrium, thus affording one of the two known exceptions to the rule that the Medusæ of the Campanularian Hydroids are of the type which carry lithocysts on the margin of the umbrella, and have their generative elements developed in special sexual buds which arise from the radiating canals,—the other exception occurring in the Medusa which Agassiz has referred to *Lafoëa cornuta*, Lamx.†

It will also be seen that the Medusa of *Leptoscyphus* resembles in all essential points the form for which Forbes has constructed his genus *Lizzia*; and I have little doubt that, when mature, its characters would entirely correspond with this medusal type. I should accordingly have had no hesitation in assigning to the present Hydroid the name of *Lizzia*, instead of constituting for it a new genus, were it not that Claparède has found, in an undoubted *Lizzia*, that

* From λεπτός, delicate, and σκύφος, a cup.

† *Thaumantias*, though a Campanularian, is destitute of lithocysts, but its sexual buds are developed from the radiating canals.

the Medusa is produced directly from the egg without the intervention of a polypoid trophosome*.

The absence of a trophosome affords a differential character of much importance; and the name of *Lizzia* must accordingly be confined to such Medusæ as, with the form of *Lizzia*, are directly developed from the egg, while it may be provisionally used for such as resemble them, but have not yet had the other terms of their life-series discovered; the detection of these will determine the genus, *Lizzia* or *Leptoscyphus*, or possibly some other still, to which the provisionally named Hydroid may belong.

Leptoscyphus tenuis, Allm.

2. LAFOËA, Lamouroux.

Trophosome.—Hydrocaulus creeping and adherent, or erect and rooted by a filiform hydrorhiza; hydrothecæ sessile on the hydrocaulus, or pedunculated, tubular, destitute of an operculum. Polypites cylindrical, with the tentacular verticil surrounding the base of a spherico-conical metastome.

Gonosome.—Gonophores phanerocodonic. Medusæ deep bell-shaped, with short manubrium, four radiating canals, and four marginal tentacles with bulbous bases, destitute of ocelli; tentacles alternately long and short; lithocysts not present.

I have described the Medusa on the authority of Agassiz. It was observed by Mr. A. Agassiz on a Hydroid which his father refers to the *Lafoëa cornuta* of Lamouroux. In this observation we have thus a second example of the production among the Campanularida of Medusæ belonging to the type which is destitute of lithocysts and develops its generative elements in the walls of the manubrium. The first recorded instance was described by myself some years ago in *Leptoscyphus tenuis*.

Lafoëa dumosa, Linn. (sp.), = *Campanularia dumosa*, Fleming, Johnst., = *Calycella dumosa*, Hincks.

Lafoëa cornuta, Lamx.

Lafoëa fruticosa, Sars, = *Campanularia gracillima*, Alder.

Lafoëa plicatilis, Sars.

Lineolaridæ.

1. LINEOLARIA, Hincks.

Trophosome.—Hydrocaulus a creeping and adherent tube carrying the hydrothecæ from distance to distance along its length; hydrothecæ sessile on the hydrocaulus, tubular, with the orifice subtriangular and armed with an earlike projection on each side. Polypites not known.

Gonosome.—Gonangia large, oviform, and adherent, sessile on the creeping hydrocaulus. Gonophores not known.

The genus *Lineolaria* was constituted by Hincks for a remarkable

* See Claparède in Zeitschr. f. wissens. Zool. Band x. 1860.

Australian Hydroid, of which, however, he possessed specimens of only the dried periderm. It would seem to offer one of the connecting forms by which the Campanularian pass into the Sertularian Hydroids through *Coppinia*, *Reticularia*, and *Grammaria*; but, in the absence of all knowledge of the living animal, it is impossible to speak with decision as to its affinities.

Lineolaria spinulosa, Hincks.

XXXVI.—*Descriptions of new Genera and Species of Eumolpidae from the Collection of the Rev. Hamlet Clark.* By the Rev. T. A. MARSHALL.

THE time has not yet arrived when a satisfactory arrangement of this interesting yet difficult group can be hoped for by entomologists. The literature of the subject is in so confused and imperfect a state, and the undescribed forms are so numerous, that the materials for generalization are yet wanting, and much time must elapse before a sufficient groundwork for the systematist can be established. The existing materials require to be thoroughly sifted, and several hundreds of undescribed species to be defined, before the work of organization can begin. To the former of these tasks, with a view to attempting the two latter, the present writer has been led to direct his attention; he is therefore enabled to speak with some certainty of the nature of the difficulties to be encountered. With respect to the hitherto published genera and species, it is perhaps not too much to say that one-half are insufficiently characterized, and rather impede than facilitate future labours. The writers in whose widely scattered works these descriptions are to be found vary much, as may be supposed, in their style and accuracy: a few only have performed their task in a perspicuous and permanent manner. Foremost among these is Mr. Baly, whose labours in this department are beyond all praise for minute accuracy and clearness. The descriptions of Prof. Boheman, of Blanchard, Germar, Thomson, Say, Lucas, Gerstäcker, Leconte, and a few others are easy of verification. It is to be regretted that most of the other authors whose names are attached to described species have contented themselves for the most part with a brief and insufficient diagnosis, and often a mere indication. A few only of the genera can be regarded as permanently established: even the well-known *Colaspis*, as at present defined, will not exclude a number of forms obviously distinct. The uncharacterized genera of Dejean's Catalogue embrace for the most part apparently natural groups, or at least they may be made to do so by a system of judicious exclusion. We will therefore first direct our attention to them, from a conviction that the conver-

sion of any one of these from a mere *nominis umbra* to a substantial reality will be a step in the right direction.

The following list will show which of Dejean's or Chevrolat's genera have been described; an asterisk prefixed denotes that they are only described imperfectly. We have also prepared a catalogue of described species of the entire group of the Eumolpidæ, which is far too long for insertion here; but, as it is necessarily in a state of progressive improvement, its publication may well be delayed to a future occasion. In the following list, small capital letters indicate the name now adopted: references to the descriptions are added, as their insertion may be of some utility.

- *COLASPIS, *Fab.*—Laporte, *Silb. Rev.* i. 21.
- *PLEURAUACA, *Chevr.*, now COLASPOIDES.—Laporte, *ibid.*
NODA, *Chevr.*—Blanchard, in Gay's *Hist. de Chile*, t. v. p. 546.
- *ACIS, *Chevr.*, now COLASPOSOMA.—Laporte, *Silb. Rev.*
DIA, *Dej.*, now COLASPIDEA.—Laporte, *ibid.*, and Redt. *Fn. Austr.*
FIDIA, *Dej.*—Baly, *Journ. Ent.* vol. ii. (1863) p. 153.
- *METACHROMA, *Chevr.*—Leconte, *Proc. Acad. Philad.* 1858, p. 85.
- *TYPOPHORUS, *Chevr.*—Erichs. *Archiv, Consp. Fn. Peruv.* (1847), p. 163.
- BROMIUS, *Chevr.*—Redt. *Fn. Austr.*—Partly ADOXUS, *Kby. Fn. B. Am.* p. 209, and Baly, *Journ. Ent.* ii. (1863) p. 149.
- EUMOLPUS, *Kugelan.*—Weber, *Obs. Entom.* p. 28.
- PLATYCORYNUS, *Chevr.*, now CORYNODES, Hope, *Manual*, pt. 3. p. 162, and Gerstäcker in Peters's *Reise nach Mossambique*, p. 335.
- CHRYSOCHUS, *Chevr.*—Redt. *Fn. Austr.*
- EURYOPE, *Dalman*, *Ephem. Entom.* p. 17.
- *HETERASPIS, *Chevr.*—Leconte, *Coleopt. of Kansas and East New Mexico*, p. 23, in *Smithsonian Contributions to Knowledge*, vol. xi. 1860.
- *GLYPTOSCELIS, *Chevr.*—Leconte, *Proc. Acad. Philad.* 1859, p. 81.
EUBRACHYS, *Dej.*, now PSEUDOCOLASPIS, Laporte, *Silb. Rev.* i. 23.
- MYOCHROUS, *Chevr.*—Blanchard, in Gay's *Hist. de Chile*, t. v. p. 543.
- PACHNEPHORUS, *Chevr.*—Redt. *Fn. Austr.*

Colaphus is omitted, as not belonging to the Eumolpidæ. *Bromius* will probably have to be retained (as only partly synonymous with *Adoxus* of Kirby and Baly) for the reception of *B. hirtus*, *Fab.*, and its allies, which are excluded by Mr. Baly from the genus *Adoxus*. *Bromius* (one of the names of the god of wine) was adopted with special reference to the habits of *B. vitis*, *Fab.*, which destroys the vines in Southern Europe. It would have been better therefore to have preserved the name *Bromius* than Kirby's *Adoxus*. That writer proposed, it would seem, to discard *Eumolpus* altogether, inventing the two names

Adoxus (inglorious) and *Eudoxus* (glorious) instead. The former appellation he applies to the small dark species of Europe, and proposes the latter for *Eumolpus ignitus*, Fab., and its congeners, the large gorgeous beetles of South America. Such inconsistencies, however, involving the mere propriety of names, are of little moment.

It will be seen, then, that of the 59 genera proposed in Dejean's Catalogue only 19 have any real existence, leaving us a balance of 40 to describe or reject, as the groups indicated may seem to require. Hardly any of these genera can be regarded as unnecessary, or wholly superseded by the described genera of more modern authors. So great is the diversity of the species they have been forced to include, that the old names may still in most cases be utilized. For example, Mr. Baly's genus *Geloptera* has hitherto been included under *Edusa*, chiefly, it would seem, because the forms are all Australian. These two genera are now sufficiently distinct; and the true *Edusa* only needs characterization to make it a good genus. No valid reason can be given why names long known to collectors, and recognized as convenient expressions, should be suffered to fall into oblivion. As a matter of convenience, they should rather, when possible, be described and perpetuated; thus the collector will find that, instead of having to learn a new name, the old idea fixed in his mind has, to his great advantage, assumed a real and permanent existence. For the future, it is to be hoped that every inventor of MS. names will meet with the treatment due to so silly and reprehensible a practice.

I proceed to describe the first uncharacterized genus of Dejean's Catalogue, *Metaxyonycha*, Chev., separated by him from *Colaspis* upon slight, although perhaps sufficient, grounds. Fourteen species are before me, presenting considerable diversity of appearance. I have indicated the group or subgenus to which each appears to belong, under each species. I purposely abstain from making these subdivisions until the remainder of the species shall have become known to me. The differences to which I refer concern chiefly the striæ of the elytra, the convexity of the thorax, and other details, none of which appear to be of sufficient value to justify the multiplication of genera.

Genus METAXYONYCHA*, Chev., D'Orb. Dict.

Colaspis, Fab. *Colaspis* (pars), Dej. Cat.

Caput verticale, thoraci haud ad oculos usque insertum, inter oculos

* I have spelt this name correctly for the first time. The derivation (*μεταξύ* and *ὄνυξ*) is given by Chevrolat in D'Orbigny's Dict. s. v. *Metaxyonycha*. Cf. a similar mistake in *Lozotæta*, *Lozogramma*, for *Lozot.*, *Lozog.* (Lepidoptera), &c.

impressum; oculis rotundatis, plus minus prominulis, rarius emarginatis.

Antennæ infra oculos insertæ, filiformes, tenues, corpore dimidio longiores: articulus primus oblongus, robustus; secundus quadruplo minor; tertius duobus primis conjunctim visis æqualis, quarto longior, gracilis; quintus ad undecimum æquales; ultimus brevissimus, gracilior, obtuse conicus.

Labrum oblongum, convexum, angulis anticis rotundatis: mandibulæ bidentatæ.

Palporum maxillarium, articulus ultimus elongatus, apice obtusus, articulo secundo æqualis; sequentes apicem versus incrassati; tertius dimidio brevior præcedente et sequente.

Thorax transversus, subquadratus, lævis, angulis anticis subito deflexis, acutiusculis; lateribus marginatis, medio obsoletius bidentatis vel bisinuatis vel denique muticis; basi truncatus, sæpe utrinque foveolatus.

Scutellum parvum, triangulare, apice obtuso, læve, rarius punctulatum, interdum elytris non concolor.

Antepectoris segmentum antero-laterale triquetrum, thoracis angulum non attingens.

Prosternum postice attenuatum, superficie fere æquata; in *Colaspide* idem medio præeminet.

Mesosternum antice bisinuatum, angulis anticis rotundatis, posticis acutiusculis.

Elytra thorace latiora, plus quadruplo longiora, oblonga, parallela, dorso convexa, posterius lente declivia (in *M. chlorophana* &c. deplanata, apice subito clausa); punctato-striata, intervallis plus minus costatis (in *M. chlorophana* haud costatis); alis amplis.

Pedes elongati, graciles, femoribus (præsertim posticis) nonnihil incrassatis; tibiis intermediis extus ante apicem plus minus emarginatis; tarsorum articulo primo sequentibus duobus æquali; unguiculis simplicibus, intus ad normam hujus familiæ appendiculatis.

Type of the genus, *Colaspis quadrimaculata*, Oliv.

The characters of this genus, taken separately, are almost identical with those of *Colaspis*; but the different facies, representing the aggregate of numerous small discrepancies, is sufficient to separate the two. The middle of the prosternum is more or less protuberant in *Colaspis*; in the present genus it is almost plane. The intermediate tibiæ are not emarginate in *Colaspis*. The head and thorax of *Metazyronycha* are smaller in proportion, and the latter less profoundly punctured, more obsoletely dentated at the sides, more convex anteriorly, and more rapidly deflexed towards the anterior angles. The antennæ and legs are longer and more slender.

Some of the species are the largest of the group, and all are natives of tropical America. The typical colour is testaceous,

with or without cyaneous blotches or black dots, usually four in number, upon the elytra, which, in a few instances, are wholly cyaneous. The thorax is always testaceous.

Four species have hitherto been described—*4-maculata*, Oliv., *granulata* and *chloroptera*, Germ., and *testacea*, Fab. Chevrolat (D'Orbigny's Dict. s. v. *Metazyronycha*) gives *Eumolpus pictus*, Perty, as appertaining to the genus. I have a specimen of this insect before me, from the Marquis la Ferté's collection, where it stands as *Endocephalus pulchellus*, Dej. It belongs to a widely different group, and will probably form a new genus, allied to *Endocephalus*.

Eighteen or twenty undescribed species appear to exist in collections. Those which I have before me may be thus tabulated:—

I. Elytra testacea.

A. Immaculata, costata.

α. costis alternis altius elevatis *granulata*, Germ.

β. costis omnibus aequalibus; antennis

* testaceis, medio nigris *testacea*, Fab.

** nigris, basi testaceis *Tejucana*, ined.

B. Maculata.

α. maculis magnis cyaneis.

* maculis 2 maximis *conneza*, ined.

** maculis 4-6; tarsis

† obscuris *crucifera*, ined.

†† testaceis; antenn. artic. 8^o.

§ testaceo *4-maculata*, Oliv.

§§ nigro; antennæ

† graciles, colore

¶ fusco, basi testaceæ *chlorospilota*, ined.

¶¶ totæ testaceæ *humilis*, ined.

†† hoc in genere crassiusculæ *4-notata*, Dej., ined.

β. punctis 4 nigris; punctis anterioribus sitis

* in callo humerali *humeralis*, ined.

** medio inter marginem et suturam *tetrasticta*, ined.

II. Elytra cyanea v. viridia.

α. costata, costis completis *tricolor*, Perty.

β. striatopunctata, costis apicalibus; margine laterali

* testaceo *chloroptera*, Germ.

** concolore *amasia*, ined.

Metazyronycha conneza, sp. ined.

M. oblonga, convexa, testacea; antennarum articulis 4-12 nigris; thorace nitido, parce punctato: elytris costatis, punctatis, punctis inter costas gemellatis; singulis macula magna oblonga cyanea, medio intus emarginata.

Long. lin. 5½, lat. hum. 2 lin.

Head very finely punctured, more strongly in the interocular fovea: eyes small, æneous; mandibles tipped with black. First

three joints of the antennæ testaceous, the rest fuscous. Thorax faintly emarginate at the sides, without denticulation: disk smooth, shining, with irregular punctures, much larger than those of the head; in the middle an impunctate space. Scutellum shining, impunctate. Each elytron with eight smooth costæ (exclusive of the sutural and lateral margins); the first, next the suture, continued to the apex; the second and eighth branching from a common stem near the apex, and including within their fork the third to the seventh. The fourth and sixth likewise originate from a common stem, which unites with the second near the apex. The interstices punctate-striate, the punctures geminated. Each elytron with a large, oblong cyaneous blotch extending four-fifths of its length, bordered all round with testaceous, and emarginate in the middle of its interior edge. Extreme tips of the tibiæ and the whole tarsi reddish brown; the rest entirely bright testaceous, deeper on the head and thorax.

Brought from Tejuca, Brazil, by the Rev. H. Clark.

Metaxyonycha crucifera, sp. ined.

M. testacea, antennarum articulis 4–12 nigris; thorace elytris multo angustiore, lateribus medio indistincte subbidentatis; elytris haud costatis, fortiter confertim subseriatim punctatis, singulis plagis duabus magnis cyaneis.

Long. lin. 4, lat. hum. $1\frac{1}{2}$ lin.

Very similar to *M. connexa*, but distinguished by having the thorax much narrower in proportion, and very obsoletely bidenticulate at the middle on each side. Elytra punctate-striate, the striæ indistinctly geminated; the interstices between each pair smooth, slightly raised, but not costate as in *M. connexa*. Each elytron with a large cyaneous blotch, bisected at right angles by a narrow testaceous stripe, forming four cyaneous spots upon the back; the two anterior spots quadrangular, rounded in front; the two posterior triangular, nearly reaching the apex. The testaceous suture and the transverse stripe form together a Roman cross, from which the species is named. In other respects similar to *M. connexa*.

Hab. Mexico. From Thomson's collection.

Metaxyonycha chlorospilota, sp. ined.

M. testacea, subnitida, antennarum articulis 6–12 nigris; thorace parce punctulato, lateribus medio edentatis; elytris subcostatis, punctato-striatis, punctis inter strias gemellatis; singulis maculis duabus cyaneis, altera humerali, altera pone medium laterali.

Long. lin. $4\frac{1}{2}$, lat. hum. $1\frac{1}{2}$ lin.

Similar to the two preceding, but subnitidous and more

faintly punctured; the less glossy appearance is due to a very minute aciculation, visible under a strong lens everywhere between the punctures, and especially on the thorax. Elytra each with eight smooth, subelevated, somewhat indistinct costæ (exclusive of the sutural and lateral margins); the first and eighth, the second and seventh, and the third and sixth united at their apices. Interstices moderately punctured, the punctures of the second and following striæ geminated. Each elytron with two cyaneous spots, irregularly rounded,—the anterior covering the humeral angle, and projected for a short space into the deflexed lateral margin, reaching along the anterior margin nearly to the scutellum, and terminating posteriorly at one-fourth of the length of the elytron: its hinder interior angle truncated. The posterior spot is situated just behind the middle, equal in size to the anterior, slightly infringing upon the deflexed lateral margin, not touching the suture, and terminating posteriorly at five-sixths of the length of the elytron. Tarsi testaceous. The other characters are common to this and the two preceding species.

Hab. South America? From Thomson's collection.

Metaxyonycha humilis, sp. ined.

M. testacea, parallela, cylindrica; antennis testaceis; capite basi et post oculos infuscato; elytris thorace parum latioribus, hoc lateribus muticis, illis subseriatim punctatis, apicem versus costatis; utroque maculis binis baseos et fascia pone medium, postice emarginata, extus apicem versus producta, nigris.

Long. lin. $3\frac{1}{2}$, lat. hum. $1\frac{1}{2}$ lin.

Head smooth, shining, with a large punctured fovea between the eyes, and three impressed lines, forming a bisected triangle, of which the apex enters the fovea. Eyes large, black, and prominent. Mandibles tipped with black. Occiput dark brown, black behind the eyes; the dark tint extending forwards in the middle indeterminately. Thorax convex, subcylindrical, moderately rounded at the edentate sides, nearly as broad as the elytra, punctured, and, with the scutellum, reddish testaceous. Elytra paler testaceous, thickly but finely punctured, the punctures indistinctly arranged in striæ; the suture costate, and several smooth costæ visible near the apex. Each elytron with two oblong black basal spots, the outer one lunate, and including the humeral callus. An irregular black transverse fascia just behind the middle, touching the sutural margin, but not reaching the deflexed outer margin of the elytron; emarginate behind, and with its outer angle narrowly produced for a short distance towards the apex. Under surface and legs entirely testaceous.

This insect, by its cylindrical form and the smaller size of its spots, approaches *M. humeralis* and *M. tetrasticta*; and the three, with *M. testacea*, Fab., and others, form a group of allied species.

Brought from the Amazons by H. W. Bates, Esq.

Metaxyonycha quadrinotata, sp. ined.

M. testacea, antennarum articulis 4–12, nigris; thorace elytris angustiore, lateribus medio bisinuatis; elytris confertim, prope suturam seriatim punctatis, apicem versus costatis, costis lævibus; in singulo elytro maculæ duæ magnæ fusco-cæruleæ; antennæ crassiusculæ; tarsi subinfuscati.

Long. lin. $4\frac{1}{2}$ –5, lat. hum. $1\frac{3}{4}$ –2 lin.

Closely allied to *M. crucifera* (of which it may be a permanent local variety), but separated (1) by the thick antennæ, (2) by the punctuation of the elytra, (3) by the brownish-blue tint of the dorsal blotches. Head and thorax smooth, shining, with scattered punctures. A single punctured stria next the suture, followed, after a wide smooth interval, by a line of doubled punctures; the rest of the elytra hardly striato-punctate, except at the apex, where the usual eight smooth costæ become visible, their interstices punctured. Otherwise like *M. crucifera*.

Hab. Brazil. From Thomson's collection.

Metaxyonycha humeralis, sp. ined.

M. oblongo-ovata, subcylindrica, nitida, scite punctulata, testacea, oculis nigris; elytris punctato-striatis, cujusque striæ punctis geminatis, interstitiis lævibus, postice elevatis. Elytron utrumque maculis binis, parvis, rotundis, nigro-cæruleis, quarum altera major in ipso callo humerali sita, altera infra medium minima.

Long. lin: 4, lat. hum. $1\frac{1}{2}$ lin.

Front with three small foveæ, arranged in an arc above the antennæ and between the eyes. Thorax finely margined at the sides and base, with a scarcely visible sinus in the middle of each side; like the head, irregularly punctured and shining. Scutellum impunctate, shining, and, with the head and thorax, pale reddish testaceous. Elytra paler, broader at the base than the thorax, parallel for three-fourths of their length, thence to the apex conjointly attenuated and rounded, and in an equal degree deflexed from above: punctate-striate, the punctures geminated, the interstices shining, elevated posteriorly into four smooth costæ next the suture, and, after a wider interval, three more, of which the first is continued from the base to the apex, and connects the two cyaneous spots on their outer edges. On the humeral callus is a round cyaneous spot, angulated posteriorly, and behind the middle a much smaller discal dot.

Brought from the Amazons by H. W. Bates, Esq.

Metaxyonycha tetrasticta, sp. ined.

M. elongata, cylindrica, testacea; oculis, antennarum articulis 3-12, tarsis, maculis in utroque elytro binis rotundis nigris.
Long. lin. $4\frac{1}{2}$, lat. hum. $1\frac{1}{2}$ lin.

More elongate and cylindrical than the preceding, the elytra less convex, parallel for four-fifths of their length, more broadly rounded, and less suddenly deflexed posteriorly. Punctuation similar, but somewhat coarser; the interstices less conspicuous, except towards the costated apex. Eyes large and prominent. Uniformly reddish testaceous, the elytra paler and yellowish. Each elytron with two circular black spots, the anterior and larger situated near the base, equidistant from the suture and the outer margin; the other behind the middle, at the distance of two-thirds from the exterior margin, and one-third from the suture.

Hab. Brazil. Common in collections.

Metaxyonycha Tejucana, sp. ined.

M. maxima, castanea; oculis, mandibulis apice, antennarum articulis 4-12, tibiis extremis, tarsis nigris: oculis intus emarginatis; thorace mutico; elytris 8-costatis, inter costas seriatim punctatis; tibiis intermediis fortiter emarginatis.
Long. lin. 7, lat. hum. $2\frac{1}{2}$ lin.

Cognate with *M. tricolor*: front marked as in that species, with the addition of an impressed line upon the vertex, reaching the interocular fovea. Head and thorax with scattered punctures; the latter subquadrate, as broad in front as behind, moderately rounded at the sides, where it is broadly margined; only slightly convex, truncate anteriorly and at the base. Elytra broader than the thorax, more than four times its length, with eight smooth costæ visible from the base to the apex. The humeral callus shining and prominent. The fifth, sixth, and eighth costæ reach the callus, the seventh is abbreviated anteriorly. All the costæ are more distinct towards the sides and apex. Interstices punctate-striate, the punctures in single rows near the suture, afterwards doubled, tripled, and finally confused in the lateral spaces. Entirely castaneous, beneath paler; tibiæ darker, blackish at the apex.

It strongly resembles *Colaspis acuminipennis*, Blanch., figured in D'Orbigny's 'Voyage,' pl. 24. fig. 10.

Brought from Tejuca, Brazil, by the Rev. H. Clark.

Metaxyonycha amasia, sp. ined.

M. testacea, elytris læte cæruleis, nitidis, confertim subseriatim punctatis, apicem versus costatis; thorace lateribus bisinuato; oculis,

antennarum articulo quinto apice et sexto ad ultimum obscuris ;
tibiis intermediis vix leviter emarginatis.
Long. lin. $3\frac{1}{2}$, lat. hum. $1\frac{1}{2}$ lin.

Facies of *M. chloroptera*, Germ., but only one-third of its size, and without the testaceous limb of the elytra. Elongate cylindrical, subdepressed ; elytra parallel nearly to their apex, and then suddenly rounded. Front with a stellate fovea, above which it is broadly canaliculate. Head and thorax bright testaceous, thickly but not coarsely punctured ; the latter subquadrate, as broad before as behind, subtridentate or bisinuated at the sides. Scutellum testaceous, impunctate. Elytra densely punctate-striate, the interstices irregular ; somewhat rugose transversely on the disk, costate at the apex ; the third, fourth, and fifth costæ springing from a common stem near the apex. Under-side and legs clear testaceous.

Hab. Costa Rica. From Thomson's collection.

[To be continued.]

XXXVII.—On the Moth of the *Esere*, or Ordeal-Bean of Old Calabar. By THOMAS R. FRASER, M.D. Edin., Assistant to the Professor of Materia Medica in the University of Edinburgh.

THE REV. JOHN BAILLIE, of Old Calabar, recently presented me with a parcel containing about eighty seeds of *Physostigma venenosum*, which had been collected because of their showing indications of the attacks of an insect. In a paper on the *Esere*, or Ordeal-Bean of Calabar*, it is stated by me that "the bean has been always received remarkably free from all disease," only one form of slight and unimportant abnormality having been met with. It is therefore a source of gratification to me to have the first opportunity of modifying this expression.

These beans had been collected upwards of three months before they came into my possession. They were contained in a covering of thick soft paper, which was found to be riddled by numerous nearly circular holes, about the sixth of an inch in diameter ; and it was evident that these perforations had been caused by an insect. On opening the parcel, the beans were found adhering together by means of an abundance of silky threads. They were easily disconnected, and, on separation, a number of caterpillars were seen (generally alive, though sluggish in their movements), and a large quantity of what was evidently their excrement. The greater number of the cater-

* "On the Characters, Actions, and Therapeutic Uses of the Ordeal-Bean of Calabar," in 'Edinburgh Medical Journal,' July, August, and September 1863.

pillars were enclosed in cocoons, formed in the spaces between either contiguous beans or beans and the enclosing paper. Fifty out of the eighty beans were found with holes—a few with only one, but the majority with various numbers from two to eight. The holes were usually of a round-oval form; they extended through the spermoderm; they were situated on almost any part of the surface of the bean, though generally on the sulcus, towards its broad extremity; they had an average diameter of $\frac{1}{4}$ th of an inch; and they had protruding through them, from the interior of the bean, a quantity of excrement, loosely connected into adhering masses by the silky threads already mentioned.

On breaking the spermoderm, the place of the kernel was found to be more or less occupied by *excrement*, *cocoons* or their broken-up remains, and *caterpillars*. In the majority of affected beans, the kernel was entirely absent; in others, portions of various sizes were left, having often eroded margins and other symptoms of the attacks of the caterpillar, and being sometimes fantastically irregular in their outlines. In a few instances, and generally in such beans as had only one or two perforations through the sulcus, the kernel was entire, and a small quantity of entangled excrement only was found in the intercotyledonary spaces. These beans had probably been occupied, at some period, by only temporary boarders.

The *excrement* occurred in large quantity in proportion to the number of caterpillars. It consisted of little, dry, stone-grey irregular cylinders, from $\frac{1}{16}$ th to $\frac{3}{8}$ ths of an inch in length, and about $\frac{1}{4}$ nd of an inch in diameter, and it was always connected in loose bundles by the adhesive thready secretion of the caterpillar. The microscopic examination of this excrement showed two principal structures—starch-granules, generally broken up, having the characteristic appearance of these bodies in the kernel of the seed of *Physostigma*, and occupying about one-third of the field, with circular bodies about $\frac{1}{1000}$ th of an inch in diameter, having large nuclei and granular contents, and occupying the remainder of the field. Chemical examination proved the presence of large quantities of uric acid and starch, and of a little ammonia. The uric acid, when precipitated by acetic acid from a solution in potash, assumed the form of perfect, very minute crystals of either detached or clustered rhombs.

One or two *caterpillars* were generally found within each bean; only in one bean as many as six were seen, all of whom were alive and active. They are of a pale yellow colour, about $\frac{3}{4}$ ths of an inch in length and $\frac{1}{4}$ th in greatest thickness, and have six pectoral, eight abdominal, and two anal feet.

The pupæ belong to the class *Incoased* of Barmeister, are about $\frac{3}{4}$ ths of an inch in length, and of a yellowish-brown colour. The cocoons are greyish white, and always covered with entangled excrement. Sometimes one pupa only occurs in a bean, at others as many as four. In a few instances, cocoons were found with perfect pupæ; in general they contained only the cases of the developed imago.

We have thus the changes of the *complete* metamorphosis of an insect unequivocally traced; and, through the kindness of my friend the Rev. John Baillie, the perfect and several imperfect forms of the imago of this insect have been put in my possession. All of these were derived in a manner which completely precludes the chance of any error. From the same lot of affected beans that are described above, a number of caterpillars were selected at Old Calabar, and placed in a box along with several perforated beans. Cocoons were observed to be rapidly formed, and in a few days four or five live moths were obtained. I am indebted to my friend Dr. John Anderson, of this city, for the identification of this moth. Specimens of the caterpillar, cocoon, and imago were kindly sent by him to the British Museum, and were pronounced by the authorities of the Insect Department to be the *Deiopeia pulchella* (order Lepidoptera, fam. Tineidæ, Leach). The description and figure given in the fourth volume of Curtis's 'British Entomology' appear to correspond accurately with the imago in my possession.

Little beyond conjecture can be advanced on the method of the introduction of this insect into the Calabar beans. The holes in the spermoderm have always a sharply defined margin, which opposes the idea of a deposit by the *ovipositor* of the imago into the unripe and growing kernel; and the distance from the exterior of the mature pod to the seeds renders it still more improbable that the imago could reach the ripe beans for such a purpose. The most probable view is that the ovum is deposited in the cellular texture beneath the soft exterior of the young pod, that it is there hatched, and that thence the caterpillar makes its own way to the interior of the bean. It is perfectly able to perforate the hard spermoderm of the ripe seed, and has been observed to do so; indeed it has been known to make holes of considerable depth into a hard wooden board.

The Ordeal-bean of Calabar is a poison of extreme activity: hitherto no living being had been known to be able to resist its action; and, from my knowledge of its properties, I confess to having been sceptical of the existence of any animal form which could be fairly subjected to its influence and still retain its hold on life. It appeared of importance to determine, as exactly as possible, the connexion between this caterpillar and the kernel of

the bean, as, supposing the kernel to be received into its alimentary system, the existence of a special assimilative selection might be shown, or it could be determined if the caterpillar were proof against this deadly poison.

That the kernel is received into the digestive system is evinced by the presence of the characteristic starch-granules in the excrement, and is rendered certain by the following experiment.

(*Exp. 1.*) A small piece of kernel, weighing exactly 7 grains, was placed in a porcelain vessel with six active caterpillars. At the end of forty-eight hours, the kernel was found to have lost one grain in weight, and to have two holes (almost perforations) on its inner surface, of nearly the same form and size as those which occur through the spermoderm. The caterpillars were active and lively, and continued so six days after. A quantity of excrement was found in the dish, with the characters already described.

That the starch-granules of the kernel were not received into the alimentary system separated in any way from the poisonous principle was shown by the following experiments with the excrement. This was carefully separated from the numerous aggregations found outside the bean, to avoid as far as possible any admixture with broken-up kernel.

(*Exp. 2.*) One detached fragment was washed, then triturated with a little water, and a drop of this applied to the conjunctiva of a rabbit. In six minutes, it caused a contraction of the pupil, which became extreme in ten.

(*Exp. 3.*) Half a grain of the detached cylinders of excrement was triturated, moistened, and formed into a small pill, which was placed in the pharynx of a linnet. Perfect paralysis of the legs was caused in four minutes, together with marked contraction of the pupils (from $\frac{1}{8}$ th to $\frac{1}{32}$ nd of an inch in diam.), defæcation and lachrymation. In seven minutes, life was extinct. The post-mortem appearances showed that death had occurred by syncope.

From these experiments it was evident that no bad consequences resulted from the presence of the active principle of the bean in the alimentary canal of the caterpillar. To determine the result of an introduction into the vascular system, experiments 4 and 5 were tried.

(*Exp. 4.*) An incision was made through the epidermis of a lively caterpillar, and a little of the active principle of the bean (the alkaloid eserinia) was introduced. No evident effect was produced, and the caterpillar was quite active four days afterwards.

(*Exp. 5.*) With Wood's hypodermic syringe, half a minim of a solution of eserinia (a grain to 8 minims of distilled water) was

injected beneath the epidermis of two caterpillars, and into a third the same quantity of distilled water. They were all swelled out, and suffered apparently from the distention, but equally, and in forty-eight hours were all equally recovered.

(Exp. 6.) Several caterpillars were subjected in various ways to the action of hydrocyanic acid, and all quickly died. From this it was proved that this caterpillar possesses no mithridate, no universal panacea against all poisons.

It may be fairly inferred, from the preceding experiments, that

(1.) The caterpillar of *Deiopeia pulchella* feeds on the virulent poison contained in the kernel of the seed of *Physostigma venenosum*; and that

(2.) This caterpillar is unaffected by the poisonous principle of the kernel—*eserinia*.

The bearing of the second result on our ideas of vital action should not be overlooked. A somewhat analogous case is furnished by the *Anthonomus druparum*, which feeds on the kernel of *Prunus cerasus**; and the poisonous properties of this kernel are well known to depend on the hydrocyanic acid it contains†. Here, then, our difficulties are increased: *Deiopeia pulchella* is unaffected by one poison, but is rapidly killed by hydrocyanic acid; and this latter occurs in the food of another insect, *Anthonomus druparum*. If life be "the sum total of the functions which resist death," we have in these examples two organisms, each furnished with an exceptional potency of one or more of these death-repelling functions, or having bestowed on each, for a necessary purpose, a special, almost unrecognized, and certainly uninvestigated alexipharmic. Unfortunately, we have no knowledge of those intimate and primary structural changes which accompany every vital action, and our acquaintance with the perversions of such changes is quite as unsatisfactory.

Edinburgh University, April 1864.

XXXVIII.—On the Belgian Equivalents of the Upper and Lower Drift of the Eastern Counties. By S. V. Wood, Jun.

In describing the lower-Drift sands and gravels that occupy the counties of Norfolk and Suffolk, and of Essex north of Chelmsford, and which, at varying distances from the coast, pass under the Boulder-clay or upper Drift, and reappear at the surface from the denudation of the latter on the western side of

* A Manual of Entomology, translated from the German of Dr. Hermann Burmeister by W. E. Shuckard, M.E.S., 1836, p. 356.

† A Treatise on Poisons, by Robert Christison, M.D., &c. &c., 1845, p. 787.

Norfolk *, I showed that this lower Drift was but the deposit of a bay which, subsequent to the accumulation of the Red-Crag beds, advanced inland more by erosion than by depression. I also attempted to show that by the time this bay had thus reached, on the west, the western side of Suffolk, and on the south-west, the centre of Essex, a general submergence of the country terminated this accumulation of sands and gravels, and caused the precipitation, alike over those beds and over the older formations forming the terrestrial surface of the period, of the mud or clay that now occurs more or less continuously over so large a portion of the British islands, and is commonly known as the Boulder-clay. I also adverted to the probable great extension of this lower-Drift bay in an eastwardly direction over the north of Europe, from which direction the abundant pebbles of quartzite occurring in the gravels appear to have been derived.

My object is now to endeavour to show that in the Loess of Belgium and the Rhine we have the extension of the upper drift that in the British isles is represented by the Boulder-clay, and that in the Campinian sands, spread over all the north of Belgium, and enveloping beds of rolled stones, described by more than one continental geologist, we have the precise equivalent of the English sands and gravels described by me under the term "lower Drift."

The relationship of the Loess to the Boulder-clay seems to have attracted the attention of Sir Charles Lyell; for, in his memoir on the Belgian Tertiaries†, he observes:—"In regard to the relative ages of the loess and the northern drift with its erratics, the only positive information which I obtained during this tour was on crossing the Meuse from Maestricht to the right bank of that river, opposite the city. Here, in company with M. van Rymdyck, I observed that the sands of the Limburg tertiary series were covered by a bed of quartzose gravel with erratics, and this again by loess 30 feet thick. The locality alluded to is the tableland of Rassburg, near Geulem, which is about 300 feet above the Meuse, and about 450 feet above the level of the sea. The erratics are some of them very angular and more than 2 feet in diameter, consisting of quartzose slate, similar to that of the Ardennes, from which they are believed to have been transported. Such an instance of the superposition of loess to a certain class of erratics will not justify the conclusion that the origin of the loess generally was of later date than the northern drift. I should rather infer from the fact here mentioned, that the transportation by ice of large blocks was still going on when a part of the Belgian loess was deposited; in other words, the glacial epoch coincided,

* Ann. and Mag. of Nat. Hist. ser. 3. vol. xiii. p. 185.

† Quart. Journ. Geol. Soc. vol. viii. p. 281.

in part at least, with the epoch of the formation of the loess. I conceive that the more intense cold had passed away or receded northwards before the principal mass of the Loess was thrown down" *.

In his late work on the 'Antiquity of Man'†, Sir Charles reverts very fully to the subject of the Loess; but he does not express any further opinion as to the relationship borne by it to the Boulder-clay, and seems disposed to correlate it with the *limon des plateaux* of the Somme Valley.

This superposition of the Loess to the Campinian sands enve-

* In the table annexed to the paper, Sir Charles places the Loess on the same horizon as the "Brick-earth and Drift" of England, and classes it as postpliocene or pleistocene. The Brick-earth, however, I regard as of later date than the Boulder-clay, being a formation deposited in the valleys which were formed by the forces that upheaved the bed of the Boulder-sea, when extensive denudations took place, by which not only the Boulder-clay, but the lower Tertiaries skirting the Thames Valley were denuded, the Brick-earth and associated gravels having afterwards been deposited on the denuded surfaces. The term Drift has been used to designate beds of so many distinct ages, that it is impossible to say, on a correlation of deposits, what precise meaning is to be attached to it. It has been used to designate not merely the boreal deposits accumulated before the valleys existing in the newer secondary and the tertiary strata were formed, but also those accumulated since the formation of the principal part of those valleys. The terms pleistocene (or postpliocene) and quarternary are equally the subjects of confusion, as both have been used in reference, not only to deposits newer than the valleys, but also to deposits, such as the Loess and Campinian sands, that are older than the valleys, and between which latter beds and the upper Tertiaries I believe no physical break whatever to exist. I have attempted to show (Phil. Mag. s.4. vol. xxvii. p. 180) that the whole of the valleys that in England exist in strata newer than the Trias originated in series of circular movements that elevated the bed of the Boulder-clay sea, and as to such of them as are south of the Thames, or immediately adjoin that river on the north, by the additional action of rectilinear movements that supervened on the circular; and I hope in a future communication to show the origin of the valleys in similar strata of North France and Belgium to be due to the same and other contemporaneous circular movements. In this respect I regard the great physical break, caused by these circular movements at the close of the glacial epoch, as a dividing horizon, above or below which the newer deposits of this area (although differing but little between themselves, as far as concerns their organic contents,) group themselves; for though in point of time the division between either group is insignificant, yet in point of change of surface arising from subterranean convulsion, all that took place over this area since the commencement of the Jurassic period is, I believe, as nothing in comparison with the complete break-up of the surface ensuing at the close of the glacial epoch. In referring, therefore, to a deposit as "drift," except when quoting from others, I may be understood as referring to deposits older than the valleys formed by the circular movements; and it would, I conceive, tend to obviate confusion if the terms pleistocene, or postpliocene, and quarternary were in like manner confined to deposits newer than the valleys thus formed.

† London, 1863.

loping quartzite erratics, which seems to have induced Sir Charles to hesitate in referring it to the horizon of the Boulder-clay, and disposed him to place it as of somewhat later date, affords, however, to me the most satisfactory evidence that I can find of the absolute identity between the Boulder-clay and the Loess, as well as between the lower Drift of the Eastern counties and the Campinian sands of Belgium*.

The extension of the lower Drift over Essex and Suffolk, and the sharp though uninterrupted transition from it to the Boulder-clay, having been described by me in the paper before referred to, I cannot better show the position of the Campinian sands relatively to the Loess, and the extension of both of these deposits over Belgium, than by giving the substance of the description of M. d'Archiac in the '*Histoire des Progrès de Géologie.*'

M. d'Archiac †, after referring to the "Geest," which he describes as underlying the turf-beds and marsh clays of Holland, as the only deposit in that country which, by its extent and continuity, seems to belong to an earlier epoch, and to be the result of a more general cause, quotes the description given by M. Elie de Beaumont of the "Geest," as a vast deposit of quartzose sand, sometimes slightly argillaceous, in a great part of which occur small erratics, consisting both of chalk flints and of fragments of crystalline rocks—a deposit occupying the surface all over the countries of Liège, Juliers, Brabant, Gueldre, Over Yssel, Westphalia, and Lower Saxony, forming extensive heaths, and reaching to the border of the sea or to the edge of the alluvial deposits of the low countries. M. d'Archiac then, after observing that the "Geest" attaches itself in Belgium to the *sables de Campine*, so widely spread in that country, hesitates to express any opinion as to the age of the deposit, by reason of the absence of sufficient evidence upon which one could be based; and he then proceeds with the description given by M. de Beaumont of the sands of North Germany, in which he indicates them as extending from North Germany westward without interruption past the Rhine, as far as the environs of

* With respect to the erratics underlying the Boulder-clay, it may prevent misapprehension if I observe that the terms upper and lower Drift, that I have adopted to distinguish respectively the Boulder-clay and the thick deposit of underlying sands and gravels, in no way represent the terms "upper and lower erratics" adopted by the late Mr. Trimmer. The lower erratics of that gentleman were the Boulder-clay (*Quart. Journ. Geol. Soc.* vol. vii. p. 21), and the upper erratics (*loc. cit.*) gravel-beds described by him as resting in places on the Boulder-clay. It would seem from the observations of Sir Charles Lyell, which I have quoted, that this order of succession weighed with him in forming an opinion as to the relationship between the Boulder-clay and the Loess.

† Vol. ii. pp. 141, 142.

Maestricht, and thence into the Campine of Belgium. Here, he adds, the sand of which the deposit is formed did not probably come from any great distance, being to all appearance derived from the degradation of the sands of the older Tertiaries, upon which it rests, both at Maestricht and in part of the Campine; while included in it are an abundance of flints, intermixed with a proportion of erratics, derived from the Ardennes and from the mountains skirting the Rhine.

In describing this deposit as covering the plateau of St. Peter's Mount at Maestricht, M. d'Archiac observes that its included erratics consist mostly of quartzites, of sizes varying from that of the fist to that of a walnut; and he adds that he regards the deposit as of the same age as the erratic beds, containing mammalian remains, which occur at the bottom of the valleys, and even on their sides, and on some of the surrounding plateaux, from the Rhine to the Channel, and which on the English side crown nearly all the chalk cliffs and detached tertiaries that overlie them.

Along the road from Tongres to Maestricht, adds M. d'Archiac, this diluvium disappears under another Drift-deposit of yellow sandy clay, true *Lehm* or *ancient alluvium* which envelopes the country like a mantle to a thickness of from eight to ten metres.

He then extracts from the 'Coup d'Œil sur la Géologie de la Belgique,' of M. d'Omalius d'Halloy, the description of that geologist, given in almost similar terms to those adopted by M. Elie de Beaumont,—the distinction between the overlying *Loess* or ancient alluvium, and the underlying sandy beds with erratics, being particularly shown.

Although, according to the view I take of the division that exists between deposits that are older and those that are newer than the valleys, there is in M. d'Archiac's identification of the Campinian sand with the gravels that cap the deposits along the coast of England a confusion of beds of different ages*, yet it is apparent from the description of the Belgian beds given by himself, as well as from those of the eminent geologists quoted by him, that the Campinian sands, with their associated and included beds of rolled stones, pass under the *Loess*, but are distinctly divided from it in the same manner as I have shown to be the case with the lower Drift and Boulder-clay. The elabo-

* The lower-Drift sands and gravels capping the Tertiaries of East Anglia, and which underlie the Boulder-clay, are, like that deposit, according to my views, older than the valleys; but the gravels and other accumulations of debris along the south coast, that sometimes cap the Chalk and sometimes the Tertiaries, are newer than the valleys of East Anglia, and even, as I believe, to a certain extent differ in age among themselves.

rate geological map of Belgium, by the late M. Dumont, indicates in a still clearer manner the area occupied by the Campinian sands and rolled stones, and by the overlying Loess, as well as the relative positions of the two beds * ; and in the following woodcut map I have reproduced, as well as the small scale will allow, the distribution of the two beds, as shown on the map of M. Dumont, adding to it the area of the eastern border of England, for the purpose of enabling a comparison to be made of the distribution and position there of the Boulder-clay (*h*) and underlying lower Drift (*g*), with the Loess and Campinian beds of the Continent. In Belgium the grouping of the two deposits shows that the valleys have been in some cases cut through the Loess down to the Campinian sands, where that deposit underlies the Loess, as, for instance, in the neighbourhood of Brussels and of Bilsen ; but in this respect the grouping of the beds is much less striking than in the case of the eastern counties of England. The coincidence between the valleys cut through the Loess and those of England, in point of time and mode of origin, is shown in a way that the limits of this paper do not permit me satisfactorily to enter upon. In the paper on the formation of the valleys, before referred to, I attempted to show that the valleys of the east of England, which cut through the upper and lower Drift of that region, resulted from the denudation having been regulated by the disturbance of the floor of the sea of the upper Drift, which took place in the form of a series of circular movements. The more important of these movements affecting that part of England originated in three centres, one of which was near Canterbury, another immediately south of the Isle of Wight, and another in the North Sea, off Flamborough Head †.

So far as I have been hitherto able to trace them, the circular movements emerging from these three centres, with others of similar character and simultaneous origin emerging from centres on the Continent, appear wholly to have formed the valleys which

- * The three deposits are by him placed in the following descending order:

Loess (limon Hesbayan) ;
Sables Campiniens ;
Cailloux roulés.

† Although these three series form the principal valleys of this part of England, a close investigation of the Ordnance Sheets appears to disclose other inequalities of surface, that are parts of circles originating at much more remote centres, and whose effect has, from distance, become proportionately feeble. I hope at a future day to show the whole grouping of these circular phenomena, and the effect of their reciprocal pressure in France and Belgium, as well as in England, and the manner in which, in the south of this country, subsequent but more localized and powerful movements have supervened on them. The short notice of them published in the 'Phil. Mag.' is very incomplete, and in some respects imperfect.

Map showing the Distribution of the Loess and Campinian Sand of Belgium and of the Boulder-Clay and Lower Drift of the East Coast of England.



- a. Secondary.
 - b. Tertiaries older than the Red Crag.
 - g. Lower Drift of England.
 - g'. Lower Drift of Belgium (sables Campiniens).
 - h. Boulder-clay.
 - h'. Limon Hesbayen (Loess).
 - x. Valley alluvium.
- The broken line indicates the supposed southerly limit of the lower-drift bay.
- } Upper Drift.

cut through or exist in the Loess itself. If, therefore, the Boulder-clay or upper Drift of England has been acted upon by movements which have similarly affected the Loess of Belgium, it follows that both deposits had been thrown down before these movements began. It can be shown that these movements have not affected the postpliocene gravels that rest on surfaces from which the upper Drift has been denuded*, so that they must have originated prior to these gravels having been deposited; and since, from the great area over which the denudation has extended, we can attribute it to nothing but the action of the sea, we must assume either that it resulted during an emergence of the bed of the upper-Drift sea, or that a second general submergence and elevation took place. Although the evidence collected by geologists appears to me to indicate that parts of the south of England and of the north of France have been submerged (and that violently), and still further denuded, subsequently to the general disturbance and denudation produced by these circular phenomena, and subsequently to the area having been converted into land, yet there is no trace of any second *general* subsidence and elevation. It therefore seems to me that we have no alternative than to infer that these circular movements originated under the upper-Drift sea; and in that case, as the Loess is disturbed by those movements, it must have been deposited prior to the elevation of the bed of that sea.

In describing the lower Drift of the Eastern Counties, I dwelt upon the mode in which the position occupied by it relatively to the lower tertiaries indicated that the bay depositing it advanced inland by erosion as much as or more than by depression—differing entirely in this respect from the overlying Boulder-clay. The latter in the east of England, where not denuded, spreads evenly over the Eocene tertiaries which the lower Drift had not reached, and over the cretaceous and oolitic deposits where they come out from under the Eocene by original relationship of deposit. In this respect the Boulder-clay fully resembles the Loess, although in the eastern counties of England there were at the time of its deposit no eminences that, rising above the sea, escaped its envelope, as did the higher ridges of the Ardennes.

On the other hand, we have, in a section given by Sir Chas. Lyell in his paper on Belgium before referred to, a parallel, in the case of the Campinian sands, to the erosive action exerted by the sea of the lower Drift. The section is that at Dieghem, seven miles north-east of Brussels. Sir Charles describes sands at that

* The postpliocene gravels of the Thames valley have, however, been powerfully disturbed by the movements *subsequent* to those of the circular character.

place as lying upon the deeply eroded face of the Eocene tertiaries; but, being unfossiliferous, he does not identify them. A reference, however, on M. Dumont's map to the place where this section occurs leaves no doubt that the covering sands shown in the section are those mapped by M. Dumont as the *sables campiniens*. A short distance south of this place the sands pass beneath the Loess that, according to M. Dumont, caps the heights on either side of the valley at Brussels.

The precise margin of the lower-Drift bay, which, as I have shown, can be detected accurately at one part of Essex, appears to be obscured in Belgium beneath the Loess. By analogy and by assuming a uniformity of depression over either area to have taken place on the introduction of the upper Drift, we may infer that the margin of this bay in Belgium passed along the northern flank of the Ardennes, from which it derived the quartzites that constitute so considerable a proportion of its included pebbles, the Loess spreading over this margin and concealing it, as is the case with the western margin, that, in Essex, passes under and is hidden by the Boulder-clay.

In another section, given by Sir Charles Lyell, he shows the Loess at Tournay to rest upon the lower beds of the Eocene series, which there crop out, at their original margin of deposit, without (so far as the section represents) any intervening bed of sand or rolled stones. It would thus appear that the margin of the lower-Drift bay passed to the north of Tournay. In another section at Dileghem, two miles N.N.W. of Brussels, Sir Charles shows the Loess resting upon a bed of sand, which, although unfossiliferous, he refers, from similarity of appearance, to the same sands as those described by him at Cassel as belonging to the Diest group. The Diest sands, however, are not indicated by M. Dumont anywhere west or south of a point about ten miles north-east of Brussels—a still greater distance from Cassel. Dileghem, where this section occurs, is represented by M. Dumont as at the margin of the Loess and the Campinian sands, where the latter pass under the former. It would seem, therefore, that the unfossiliferous sands of Dileghem, upon which the Loess rests, belong to the Campinian series, the more especially so as we have seen that at Dieghem, a few miles only N.E. of the former place, the Campinian sands shown to occur there by M. Dumont agree with Sir Charles's section of that place. If, therefore, the Loess at Dileghem is underlain by the Campinian sands, the margin of the lower-Drift bay would pass somewhere between that place and Tournay; but if otherwise, it would pass between Dieghem and Dileghem. I, however, for the reasons stated, strongly incline to the former alternative, and I have adopted it in the hypothetical extension of the boundary given

in the woodcut map *. The great extent of the lower-Drift bay in the direction of the north of Germany, and even further still to the eastward, becomes, I think, demonstrable; but, as I observed in the description of the beds in the Eastern Counties ('Annals' for March 1864, p. 199), only a small portion of that bay impinged upon England. In the map accompanying that description, I did not draw the line indicating the probable boundary of the bay in England further north than the western side of Norfolk, in consequence of not having been able to make the necessary observations along that border to enable me to indicate the boundaries in that direction; I, however, believe that the boundary, after crossing the south-east of Lincolnshire, skirts the east of that county and runs northwards by Hull towards Bridlington; but for the present I defer any remark as to that extremity of the deposit.

The descriptions of M. d'Archiac, of the extension of the ancient diluvium over the north-east of France, do not enable one to form an opinion as to how far the conditions that prevailed during the Drift period on the northern side of the Ardennes existed also on the southern. It would seem from the descriptions of the French geologists, that the upper Drift (*i. e.* the Loess, or limon Hesbayen) occurs in the north-east provinces of France, south of the Ardennes; but to what extent, if at all, the lower-Drift beds may be there represented, these descriptions do not enable me to form any clear opinion. M. d'Archiac draws no distinction, such as I believe does exist, between gravels that are older than the valleys formed in the cretaceous and tertiary strata, and those that are newer than those valleys, as is evident from his identification of the Maestricht sand containing rolled quartzites (and which he describes as passing under the Loess towards Tongres) with the

* Sir Charles points out the difficulty of distinguishing between the sandy base of the Loess and the Eocene sands upon which it rests, by reason of the occurrence of a large number of derivative fossils in the former, washed out of the latter. This fully bears out the statement quoted from M. Elie de Beaumont, as to the source from which the Campinian sands have been supplied with their material. Sir Charles also instances cases in which M. Dumont, from this presence of derivative fossils, regarded as of Loess (Campinian) age beds which he (Sir Charles) was inclined to refer to the Eocene; and it would seem, from the grouping on M. Dumont's map of the Campinian and Loess beds, that this divergence of view is the cause of the discrepancy I have been discussing in the representations at Dileghem and Dieghem. As the Campinian beds thin out towards their margin, near the Ardennes, their distinction from the subjacent Eocene becomes probably more obscure than it is further to the north, where, from their greater thickness and from the presence of their included erratics, a general concurrence of opinion exists as to their existence beneath the Loess.

gravel-beds overlying the chalk, and also the detached Tertiaries on the English side of the British Channel—beds which I regard as wholly of newer date than the valleys, and consequently of newer date than either of the beds forming the subject of this paper. Of the lowermost of the latter beds, I have shown that its margin crossed the centre of Essex; but that portion of the upper Drift which in England is known as the Boulder-clay, I believe, originally extended continuously over the area south of the Thames, and was the more oceanic portion of that part of the upper Drift which formed the Loess of Belgium—and that the same formation spread over northern France. No remnant, however, of this upper bed, south of that at Muswell Hill, six miles north of London*, has, so far as is yet known, survived the denudation, which removed not only that bed, but large areas of the Eocene beds also; so that the gravel-deposits crowning the surface of the denuded Chalk and Tertiary on the English side of the Channel are in no way connected with either of the beds which form the subject of this paper.

In this uncertainty attending the spread of the upper Drift over France, I have not attempted to pursue the correlation of the deposits beyond Belgium; but it is apparent, from the views I take, that I regard the *limon des plateaux* which caps the chalk heights overlooking the valley of the Somme, and which Sir Charles Lyell seems inclined to refer to the Loess, as of a later date than that deposit, although I believe it to differ in age, as Sir Charles justly points out, from the deposits filling the Somme valley. According to my views, the whole mass of the Eocene tertiaries that spread from Mons en Pevèle, on the north, to Beauvais on the south, were denuded from the chalk forming the heights of the Somme, subsequent to the deposit of the Boulder-clay over those Tertiaries, and before this *limon des plateaux* had settled upon the surface of the chalk thus exposed.

The Boulder-clay of the east of England has hitherto, so far as

* Over the London Clay north of the Thames, and particularly over the south-east of Essex, stones occur not unfrequently on the surface of the soil, that never came from the wreck of the Eocene tertiaries, but well agree with those included in the Boulder-clay: these I believe to have come from that deposit, and, having escaped the transporting agencies in operation at the time of the denudation, to have settled on the denuded surface of the London Clay, and in that way now convey a faint indication of the former existence of the Boulder-clay over the area where they are distributed. A boulder of crystalline rock, water-worn, containing several cubic feet, exists at Grays, and another at Benfleet; but as they may possibly have been brought by ship, it would be unsafe to rely on them as evidence of the Boulder-clay having extended, as I believe it did extend, over those places.

I know, yielded no proper fossils, its included organic remains being wholly derivative*. In Belgium, the only fossils obtained from the Loess appear to be of fluvial, or rather terrestrial habitat; and it is the presence of these latter, doubtless, that has chiefly contributed to deter geologists from referring the Loess to the horizon of the Boulder-clay. Speculations on the agencies producing these discordant features have not much to rest upon; but we may not unreasonably take into account the influence of the arctic conditions of the period as either causing or contributing to this result. The views of geologists have already been expressed in favour of a great freshwater discharge down the valley of the Rhine as the cause of the deposit of the Loess, although they have differed as to the mode in which the fresh water was distributed. It appears to me, however, that in the gorge of the Rhine we should, under arctic conditions, have one of those deep floods, described by Dr. Sutherland† as so fertile in glacier production, that now indent Baffin's Bay, with the added condition of its being the outlet of the drainage of a considerable tract of land. If a great difference between the temperature of summer and that of winter prevailed during the Loess period, more resembling the climate at the mouth of the Mackenzie and Coppermine Rivers than those of the eastern side of America, very extensive floods of fresh water would be poured down the valley of the Rhine during summer, and spread over a considerable area at its mouth. Whether this periodical disturbance of the distribution of fresh and salt water over the region near the point of discharge would render the area unsuited alike for the habitation of marine, of fluvio-marine, and freshwater mollusks is uncertain: a better knowledge than is yet possessed of what now obtains, under circumstances presenting the nearest analogy at the present day, is required before a satisfactory reply can be given; but it has occurred to me as not improbable that, since the included Mollusca of the Loess are of that habitat that they may well have been carried down from swamps or rills existing high up the Rhenish country, or among the higher elevations of the Ardennes, and sparsely distributed with the muddy sediment over the Loess area, such a state of things might furnish an explanation of the absence of either fluvio-marine or of purely marine Mollusca. The intermittent volume of the freshwater discharge would, I conceive, produce conditions quite different from those ordinarily understood as fluvio-marine,

* I am permitted by Mr. J. G. Jeffreys to state that he has recently obtained marine molluscous remains from what he regards as undoubted Boulder-clay of the Yorkshire coast.

† Quart. Journ. Geol. Soc. vol. ix. p. 30.

which result from the regular and constant intermixture of the fresh water of rivers with the sea-water. This conjecture also receives some support from the circumstance that the included shells of the Loess appear to become rarer as the distance from the Rhine increases, and from the fact that the Hesbayan mud, argillaceo-sandy in Belgium, becomes on the extreme east of Suffolk more clayey, but yet less so than further to the west, and its included chalk débris are there but scanty; while as we go westward, and approach the region of the oolitic clays, from which so much of the argillaceous material of the Boulder-clay of the east of England has been derived, the clayey character of the deposit becomes more decided. Approaching the Chalk region, as well as over it, the extensive intermixture of chalk-detritus shows that the adjacent material largely contributed to the sediment, and that little or nothing was derived from the Hesbayan area. Over the Eastern Counties also the Boulder-clay is destitute, so far as hitherto observed, of fossils; so that it would seem to form a sort of neutral ground between the Loess with its included land-shells, and the Boulder-clay of the north with its deposits of marine shells.

I have not been able to find any description of the upper Crag of Antwerp calculated to throw any light on the relationship borne by that deposit to the Campinian sands, or showing whether the transition that exists in Suffolk between the Red Crag and the lower Drift obtains also in Belgium; and, indeed, it would seem that the level state of the country around Antwerp forms an obstacle to a satisfactory investigation of that question.

* * * * *

In the paper on the "Red Crag and Drift" ('Annals,' March, p. 185) I observed, in reference to the passage-beds between the Red Crag and Drift, that I understood from Mr. Prestwich that he no longer adhered to the section of that place published by him in the Quart. Journ. Geol. Soc. (vol. v. p. 345). I, however, should have said that it was his *interpretation* of some parts of that section, and not the order of superposition, to which Mr. Prestwich does not now adhere. It will be seen, by a comparison of the two sections, that, in point of superposition, there is no material difference between them. It was in respect of the unconformability of these beds to the Red Crag that my views differed from those expressed by Mr. Prestwich in 1849.

XXXIX.—*Observations on Raphides and other Crystals.*

By GEORGE GULLIVER, F.R.S.

[Continued from p. 295.]

Crassulaceæ, Ficoideæ, and Cactaceæ.—In former examinations of a few of these plants, raphides were always found in *Ficoideæ*, and never in *Crassulaceæ* and *Cactaceæ*. Of these three orders parts (leaves when not otherwise noted) of different species have since been obtained, chiefly through the kindness of Mr. J. De Carle Sowerby, Mr. W. H. Baxter, and Mr. Cox, of which the examinations will now be given. *Crassula tetragona*: a few oblong-cubic or prismatic crystals in liber or alburnum of stem. *C. (perforata?)*: a few short, abruptly truncated prisms. *Bryophyllum calycinum*: some sphaeraphides and detached minute square crystals. *Monanthes polyphylla* (stem and leaf), *Sedum populifolium* (woody stem and leaf-buds), *S. dentatum*, *S. kamskaticum* (root and leaf-buds), *Sempervivum rubricaulis*, *S. arachnoideum*, *S. anomalum*, *S. hirtum*, *Echeveria secunda*, *E. pumila*, *E. papillosa*, *E. bracteosa*, *Pachyphytum bracteosum*, *Cotyledon? arborescens*, *C. umbilicus*, *Rochea falcata*, and *Tillæa muscosa*: no raphides, and other crystals very scanty. *Cereus hexagonus*, *C. flagelliformis*, *Rhipsalis paradoxa*, protuberances and spines of seven species of *Mammillaria*, four species of *Epiphyllum*, and two of *Opuntia* were also all devoid of raphides. But in *E. speciosum* were numerous coarse sphaeraphides, a sort of crystalline grit, from which abruptly truncated prisms radiated; and *O. nigricans* and fruit of *O. vulgaris* were thickly studded with sphaeraphides, about $\frac{1}{32}$ th of an inch in diameter, especially in the outer part of the rind; while in its inner part and parenchyma the sphaeraphides were less numerous, more irregular in size, and so much larger that their mean diameter was not less than $\frac{1}{16}$ th of an inch. Of the fifteen species received of *Mesembryanthemum*, every one abounded in raphides, commonly in bundles; and many larger crystal prisms were seen in these plants: the raphis-cells were generally of a short oval form, by no means so elongated as in many other orders, and in the centre frequently appeared black from the accumulation of raphides. This was well seen in the leaves of *M. vaginatum*, *M. densum*, and *M. caninum*, and also in the parenchyma and pith of the stems of *M. barbatum*, *M. (tortuosum?)*, and *M. perfoliatum*.

In Prof. Balfour's 'Manual of Botany,' these orders stand thus:—90, *Crassulaceæ*. 91, *Ficoideæ*. 92, *Cactaceæ*. And now all the above observations show raphides constantly present in the section *Mesembryæ* of the central order, and as constantly absent in the two other orders. Still, that this remarkable

difference exists throughout the whole of these orders seems so unlikely, that nothing short of a complete examination of them would be sufficient to establish the truth of this question. Meanwhile it may be added that I have found this raphidian diagnosis never-failing, so far as regards three species of Mesembryaceæ and ten of Crassulaceæ and Cactaceæ, being all the plants of these orders growing in my garden and in the windows of the neighbouring town. A satisfactory examination of the other sections of Ficoideæ would be very interesting. In dried fragments of *Tetragonia*, *Aizoon*, and *Sesuvium* I saw no raphides.

Rubiaceæ.—The following officinal articles were obtained, by the kindness of Mr. Ward, from the most authentic sources:—Root of *Cephaelis Ipecacuanha*; five sorts of Cinchona-bark, to wit, Red, Yellow, Yellow Petago, Pale, Yellow Carthagena; berries of East-Indian, Plantation, and Mocha Coffee. After careful examinations, no raphides were found in any of these, except in the *Ipecacuanha*: this root contained a few raphides; and they were seen more plentifully in a fresh leaf of the plant, kindly sent by Mr. Moore, the excellent Curator of Chelsea Gardens. The officinal root was remarkable (especially its outer fleshy part) for an abundance of starch; in the central woody part were many long cells full of starch-granules, and it was chiefly made up of dotted ducts, like those of *Galium Mollugo*. Of the Cinchonæ, the pale was the only one consisting of all the layers of the bark, and it contained more starch than the others. Mr. Moore also favoured me with leaves of *Coffea arabica* and *Cinchona calisaya*, in neither of which could raphides be found; nor in a twig of *Cinchona micrantha*, kindly sent, with other contributions towards this inquiry, by Mr. Baxter.

In the British Flora, we have before shown that Rubiaceæ, consisting entirely of herbaceous species, stands as a raphis-bearing order closely surrounded by orders devoid of this function; while of eight exotic plants, of the section Cinchonaceæ, raphides abound in two herbaceous species, and could not be found at all in six woody ones, though sphæraphides in *Ixion* and *Gardenia* are numerous and beautiful. Subsequently, I have examined a few species, both native and foreign, belonging to the three orders standing, in Prof. Balfour's 'Manual,' on either side of Rubiaceæ, and failed to find raphides in any one of these plants, among which were fragments of six species of the order Loranthaceæ and two of Calyceraceæ, obligingly supplied, in compliance with my request, by the eminent botanist Dr. Hooker. Thus the presence of raphides in the herbaceous species and their absence from the woody ones further appear; and hence arises, in this wide and novel subject of the value of

raphides as natural characters, another of those interesting questions which can only be settled by further observations.

Musaceæ.—Bit of midrib and blade of leaf of *Musa textilis*, from Mr. Baxter: raphides scanty; but abundance of minute crystals, like those of *Citrus* ('Annals,' April last, p. 294), besides some hexagonal forms. *Heliconia aurantiaca* (leaf from Mr. Moore): petiole and blade with swarms of raphis-cells.

Iridaceæ and *Liliaceæ*.—Such fine examples of crystal prisms, about $\frac{1}{3\frac{1}{2}}$ th of an inch long and $\frac{1}{3\frac{1}{2}}$ nd thick, are afforded by the officinal Orris-root (*Iris Florentina*), and of raphides, about $\frac{1}{4\frac{1}{2}}$ th of an inch long and $\frac{1}{13\frac{1}{10}}$ th thick, by the officinal Squill, that the difference between these crystals may be examined at any time. There are also in the Squill numerous smaller raphides; and in the fresh bulb the raphides may be seen escaping from the rounded ends of the soft, ropy and mucus-like cells. I have before noticed the raphides in the leaves of *Ruscus*. Though always rather scanty, they are constant; and many bundles of them occur regularly in the perianth. The remarkable scarcity of raphides in our native shrubs and trees gives an interest to this little British shrub as a raphis-bearer. Raphides abound in the twigs and leaves of *R. Hypoglossum* from Mr. Sowerby.

Burmanniaceæ and *Hæmodoraceæ*.—Dried leaves, from Mr. Baxter, of *Burmannia*, sp., and *Anigozanthus*, sp.: raphides not found in the first, but abundantly in the last, and often in bundles.

Amaryllidaceæ.—A good example of the constancy of the raphis-bearing character is afforded by *Narcissus pseudo-Narcissus*, as I have found after many examinations, during different months and years, of wild plants in Derbyshire, Middlesex, Essex, Kent, Ireland and Scotland. Though the raphides are so abundant in its leaves, scape, and ovary-coat, they are not remarkable in the ovules. It is curious to observe the difference between the bulb-scales either of this plant or *Endymion nutans* and of some *Alliæ* and *Colchicaceæ*: bundles of raphides in the first two, short prisms in the third, and no crystals in the last.

Hypoxidaceæ.—Bundles of raphides numerous in a dried leaf of *Hypoxis*, sp., from Mr. Baxter.

Bromeliaceæ.—Leaf of *Bonaparteia juncea*: a profusion of bundles of raphides, and of single, larger, four-sided prisms, flattened at the ends like a mason's chisel. Leaves, from Mr. Baxter, of *Ananassa sativa*, *Æchmea discolor*, *Dyckia rariflora*, *Tillandsia acaulis*, *T. zebrina*, and *T.* sp.: all abounding in raphides, which are also numerous in the stamens and perianth of an immature flower of this last species.

Pontederiaceæ.—Bit of dry leaf-stalk of *Pontederia azurea*

and of fresh leaf of *P. crassipes*, from Mr. Baxter: abundance of raphis-cells, and of crystal prisms, especially in the pith.

Xyridaceæ and *Juncaceæ*.—Bits of dried leaves of the three following, from Mr. Baxter:—*Xyris laxifolia* and *X. subulata*: no raphides. *Philydrum lanuginosum* (*Xyridaceæ*?): numerous acicular crystals lying singly along the leaf, the margin of which consists of prosenchyma, its transparent fusiform cells as long as in many sorts of woody pleurenychyma. Raphides were not seen in any of the few species examined of the British *Juncaceæ*.

Palmaceæ.—Cocoa-nut (*Cocos nucifera*), Palm-nut (*Elais guineensis*), Betel-nut (*Areca Catecu*), and Date-fruit (*Phœnix*), from shops: no raphides. Of the following, portions of leaves merely, when not otherwise noted, from Mr. Ward's fern-house, and from Mr. Moore, Mr. Sowerby, and Mr. Baxter:—*Rhapis flabelliformis*, *R. Sierotzik*, *Elais guineensis*, *Latania borbonica*, *Phœnix leonensis*, *P. dactylifera* (root, stalk, and leaf), *P. farinifera*, *P. sylvestris*, *P. humilis*, *Elate sylvestris*, *Seaforthia elegans*, *Chamærops*, two sp., *C. humilis* (bits of root and leaf), *Corypha australis*, *Areca alba* and *A. rubra*: raphides either not present or very scanty. *A. crenata*, *Thrinax parviflora*, *Chamædorea*, sp., and *C. Scheediana*: a few raphides. *Areca sapida*, *Sabal umbraculifera*, *Ceroxylon Andicola*, and *Caryota urens*: many bundles of raphides.

Pandanaceæ.—Leaves, from Mr. Moore and Mr. Sowerby, of *Pandanus utilis*, *P. spiralis*, and *Carludovica purpurata*: a profusion of raphides, the bundles of which are much shorter than their delicate translucent cells. Of this order, Prof. Balfour long since observed, "their spermoderm has numerous raphides."

Edenbridge, April 7, 1864.

[To be continued.]

XL.—*Histological Researches on the Formation, Development, and Structure of the Vegetable Cell.* By Prof. H. KARSTEN.

[Continued from p. 290.]

§ III. *On the Polarity of the Joint-cells of Cladophora glomerata.*

In an investigation of cell-development, *Cladophora glomerata* cannot be passed over, as its course of development furnished the foundation for the first theory of cell-formation, Mohl having employed it in his important and suggestive researches upon this subject—researches which have been repeated by all succeeding vegetable anatomists, who, almost without exception, have confirmed the results obtained by that highly esteemed observer.

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If, notwithstanding, I now find, after the repeated and most careful examination of this interesting plant, that the law of development laid down by me is followed also in the formation of the cells of its tissue, particular difficulties must indeed have been thrown in the way of the recognition of the true phenomena by the structural conditions of this plant.

And it is undeniable that such hindrances do exist in the mode of development of the cells of this plant,—dependent, in the first place, upon the existence of a large number of secretion-cells in the vegetation-cells concealing their youngest phases and rendering observation difficult; secondly, upon the fact that in the tissue-cells the youngest joints do not, as is commonly the case, remain a long time undeveloped and exhibit their characteristic nucleus; and thirdly, upon the circumstance that the successive endogenous development in this plant proceeds in a high degree even in the secretion-cells, whereby the distinctive characters of the vegetation- and of the secretion-cell become confused and lost.

It is partly by these circumstances that the recognition of the true developmental processes in this plant has been rendered difficult (as indeed Jessen has shown by the communication of his observations on various Algæ), but partly also by the method of investigation, in which chemical reagents have been employed as physical aids.

In the following account I shall relate my observations in the order dictated to me by the opportunities I had of making them upon the developing plants.

It has been noticed, in the case of several Algæ, that individual cells detach themselves from the cell-tissue of the organism, become free like gonidia or the buds of more complex plants, and at length produce perfect individuals. This phenomenon (which takes place in nature under certain, though as yet not fully understood, conditions) may be artificially produced in the *Cladophora glomerata*, and probably also in the other *Conservæ* allied to it.

On cutting a *Cladophora glomerata* longitudinally into small pieces, so that a cell remains in each portion uninjured between two cut ones, and on placing such sections in water (Pl. VI. figs. 30 & 48), a portion of the mucilaginous granular contents is seen to escape from the cut ends of the cells, whilst another portion will become progressively changed and dissolved by the intruding water. The single uncut cell, however, resists the action of the water at its internal transverse septa, now freely exposed, as well as at the cuticle clothing its lateral walls, which does not permit diosmosis to take place in sufficient amount to exert an injurious action upon the assimilative activity of the enclosed cell. The cell thus isolated proceeds in its development,

although at first slowly and in an altered form ; for from it, just as from a germ-cell, a perfect individual is produced.

The first perceptible change in the cell is a state of tension of each of its free transverse walls or septa. These transverse septa present, in the normal uninjured state of the *Conferva*, a flat disk ; but after the section of the neighbouring cells, they become somewhat expanded and pressed outwards from the ends of the uncut cell, so that they present a concavity towards the interior of this cell (Pl. VI. figs. 30, 31).

This extension, which is at first exerted equally on both walls, soon acts only upon one of them, and this is always the one which is naturally the lower one—a circumstance which can be best verified in such sections as have a cell branching from them (figs. 30, 31, 42). The enlarging uninjured cell now usually first of all pushes the original lower septum further downwards, within the cut cylindrical lateral wall, the diameter of this cylinder being generally not entirely occupied, by which circumstance the progress of the enlarged transverse septum may be distinguished far downwards. This inferior prolongation of the cell gradually becomes smaller in diameter and thinner than its upper portion (figs. 33, 34, 35), and it is also frequently not so thickly occupied with chlorophyll (figs. 42, 45) as are the normal joint-cells of the plant. At the same time the inferior extremity of this prolongation usually affixes itself to some dead or living organic body, it may be to a living cell of its own species, extends itself upon this in thin ramifications, and adheres closely to it (Pl. VI. figs. 43, 44, 45), by becoming intimately amalgamated, without, however, exerting any perceptible influence upon its vital activity. This direct inferior prolongation of the *Conferva*-cell thus becomes its radical extremity.

The upper end of the same cell follows an entirely different course. At first, indeed, the septum exhibits a certain degree of extension like the lower one, but I have never distinctly made out a direct elongation of the apex of the cell upwards into the empty cell above ; but when an act of growth is established in the upper extremity of the cell (an event commonly subsequent to the extension of the lower end), this expends itself laterally below the transverse septum so as to produce a branch,—the proceeding resembling that whereby ramifications are normally produced in uninjured *Confervæ*.

The branch therefore is developed within and under cover of the original enveloping membrane of the entire plant, whilst, on the contrary, the organ which represents the root of the higher plants is not covered by this general integument, but, so soon as it has emerged from the surrounding walls of the cut cell, continues to elongate itself in the water quite free and unclothed.

We here find, therefore, in the development of these two physiologically different organs, a similar phenomenon to that which obtains in compound plants; for all those parts of vascular plants which belong to the ascending axis are clothed during their development by the epidermis; whereas this covering is wanting to the root, whose divisions are invested with a layer of tissue analogous in many respects to cork, even at their growing extremities.

The normal phenomenon of root-formation from the original lower extremity of the cell of the *Conferva*, isolated in the manner described, and that of the production of a branch from its original upper end (exceptions to which rule are extremely rare) render it evident that in each of these cells there is a physiological difference between the two extremities. Moreover, in the case of the swarm-spores and gonidia of *Algæ*, which consist of only one system of endogenous cells, and are provided on one side with vibratile cilia, a similar pre-existent polarity may be recognized; for, in these, one side, and indeed that which is clothed with cilia, will always grow downwards into the root of attachment, whilst the opposite extremity of the spore, invested by the thickened mother cell, grows upwards to form the stem. This separation of the regions of the cell by reason of their endowment with different functions, which is already established by development in the parent plant, forms the basis of the dissimilarity in the arrangement of the organs of the developed plant.

In part it is the mode of nourishment of the spores and germinal cells, dependent on their position in the mother cell and in the parent plant, which engrafts upon the cell, simultaneously with its production and development, the dissimilarity in the functions of its different regions.

In part, also, this heterologous activity at the opposite poles of many germinating spores of *Algæ* and of the phanerogamic embryo in course of development, is probably founded in the anatomical difference of these poles—the extremity of the young organism which takes on the function of a root breaking through the mother cell which continues to envelope the opposite extremity as an enclosing membrane, or at least envelopes its youngest parts until the complete evolution of the normal form.

We may further look upon the vibratile cilia with which the germinal corpuscles are furnished as in part a cause of their polarity; for the cilia themselves, being extended hair-like secretion-cells (*Bot. Zeitung*, 1852), constitute the first simple organs of nutrition of the embryonic organism. Filled with a liquid which causes the taking-up of matters from the surrounding medium, these organs doubtless prepare the first nutritive matter for the cell upon which they are seated; and this matter

will be applied, especially during the dissolution of the ciliary membranes, so as to promote or produce in the adjoining region the predisposition to take on the function of a root.

Those germ-cells (gonidia) which are clothed with a uniform ciliary epithelium, as, for example, those of the genus *Vaucheria*, display no such polar tendency at their opposite ends.

On the other hand, similar conditions are encountered in the developing germ-cells of the complex organization of phanerogamous plants. In these also the mystery of the normal position of the radicle of the young plant with regard to the micropyle (independently of the mode of attachment of the ovule to the placenta, from which it receives its nourishment) will undoubtedly find its partial solution in the fact that the first impulse to the assumption of the typical form of the mature organism, which is innate in the fertilized cell, is derived from the contents of the pollen-sac, which penetrates into the ovule through the micropyle and determines the polar property of the indifferent germ-cell.

In the filiform *Confervæ*, this polar property of the germ-cell, when once set up, propagates itself to every cell, in series, throughout the organism, and is equally stamped upon every single cell in it; and the same thing takes place in the Phanerogamous plants which are composed of various kinds of tissues, by which we may explain the predisposition to polar activity inherent in every fragment of the stem or leaf, which manifests itself in the normal development of new roots at the originally inferior extremity of the organic fragment.

The desire to make this phenomenon dependent on the presence of vessels which are endowed with functions analogous to those of animals (which, curiously enough, has been quite recently again put forward) arises from a complete misconception of the structure of the tissues of plants.

§ IV.

The joint-cells of *Cladophora* are at a certain period filled with a tissue composed of secretion-cells, which arise along the middle of the cells and extend themselves to the periphery, where they dissolve.—Some of these secretion-cells have their membranes thickened.

According to the opinion now generally received, most of the tissue-cells of plants consist, at a certain period of their life, of an external membrane, a primordial utricle (second cell-wall inwards), a nucleus containing a nucleolus (the third and fourth inner cell-walls), and between the nucleus and primordial utricle a considerable amount of cloudy, granular, mucilaginous fluid—the protoplasm, plasma, or cell-juice. In this last, during the enlargement of the two outer cell-walls, irregularly disposed

cavities or vacuoles are formed, which separate the rest of the granular mucilaginous contents into two portions,—namely, a central portion surrounding the nucleus, and a peripheral one, lining the inner surface of the primordial sac; but the two are united by simple or branching fibres extending between them.

In the cells of *Cladophora* no nucleus is visible. Their plasma is described as mucilaginous, of greater density at the surface contiguous to the second inner cell, where it contains much chlorophyll and starch (and, according to Nägeli, hardens to form the inner sac [*Innenschlauch*]). The state of matters in this instance, however, is somewhat different; and a thorough discussion is necessary to enable us rightly to estimate the organization of these cellular plants, as also that of the plant-cell generally.

The contents of *Cladophora glomerata*, which escape when a section of the plant is made under water, are for the most part readily destroyed by the action of the water, so that only the corpuscles of chlorophyll and starch, and, at a later period, only those of the latter, can be discerned. These starch-vesicles frequently constitute the nuclei of the chlorophyll-grains, and advance in growth within them during the liquefaction of their substance. Further observation of the exuded substance of the wounded joint of the *Conferva*, whilst submitted to the action of water, will show that this apparently mucilaginous fluid consists of hyaline vesicles and cells, which are filled with a transparent liquid, either quite colourless or in part coloured by a greenish matter. The latter, where present, adheres like a green mucilage to the surfaces of the very delicate envelope of the cells, coats them externally or internally, and often entirely fills their cavity. The size of these vesicles varies from the most minute to others whose diameter considerably exceeds the transverse diameter of the *Conferva*. However, the determination of their original dimensions is very difficult; for all of them, at the moment the section of the *Conferva* is made, and upon coming into contact with the water, undergo an extraordinarily rapid and considerable distention, and mostly soon rupture. By causing movements in the water, the escaped delicate and yet unruptured cells may be made to roll and demonstrate the resistance to water which their membrane enables them for some time to maintain. Moreover similar delicate cells may be observed in the emptying portion of the cut joint-cell, adhering here and there to the inner surface of the secondary membrane. The central cavity of the joint-cell becomes eventually filled with water, or, it may be, with air, if the latter has been allowed to enter during the making of the section.

Several small vesicles and thin-walled cells, of the same sort,

are very commonly met with enclosed within a larger and equally delicate common cell-membrane. This outer wall, which lies at first in close apposition with the inner cells, becomes, by the imbibition of water, much removed from them, and, by the longer operation of endosmose, gets so much stretched that it becomes ruptured at some point, whereupon the hitherto smooth and structureless membrane suddenly collapses, appears granular, and proceeds to dissolve, commencing from the gaping margins of the fissure.

The vesicles and cells imbedded in colourless or greenish mucus, set free by the dissolution of the mother cell, are now likewise exposed to the action of the water, to which they yield in just the same manner as the others, usually bursting in the course of ten or fifteen minutes. If the water be only in small quantity, the expanded membrane is preserved in the surrounding mucilage for some time longer.

Former observers have remarked similar phenomena: as, for example, Meyen, in the case of the gonidia extruded from joint-cells; Saulier, in those of *Derbesia*; Unger, in *Achlya prolifera*; Itzigsohn and Hartig, the latter in *Vaucheria dichotoma*. Nevertheless they have all taken a different view of these insufficiently noticed facts; for they have looked upon the mother cell cast off from the daughter cells in the course of endosmosis (following the hypothesis of Mirbel) as originally a secreted layer precipitated around them.

Hartig says that, upon cutting through a *Vaucheria*, cell-vesicles may be seen emerging and separating themselves from it by constriction, presently bursting and emptying a portion of their fluid matter, and then, by the contraction of their integument, closing again, and swelling up anew. Moreover he affirms that two or more sacs which have been cut through may coalesce by a sort of conjugation into a single vesicle.

By repeated investigations respecting these phenomena, I have convinced myself that these apparent detachments, contractions, and repeated dilatations are nothing else than the successive expansion and dissolution of an endogenous system of cells. Those vesicles which have once burst or been cut through never unite with one another or become again distended by endosmosis, as Hartig believed he had seen them do; but they undergo a continuous breaking up. The uninjured superimposed cells in close contact with each other are with difficulty recognizable, on account of the great delicacy of their membranes, when their contents are uncoloured, and consequently they appear to form only a single cavity. By adding to the water in which the cellular contents of the *Conferva* are lying a watery solution of iodine or tannin, the phenomena of distention and bursting

take place much more rapidly in the colourless endogenous cells, especially with the latter solution, whilst their contents remain uncoloured and readily mingle with the fluid.

Sometimes, immediately on cutting through a *Conferva* in water, a large thin-walled cell, of half the length of the joint-cell and equal to it in diameter, may be seen to emerge gradually: it is filled with other vesicles, partly clear and transparent, and partly coloured green and containing chlorophyll- and starch-corpuscles. It looks, in fact, as if an entire young joint-cell were thrust out from the cell of the *Conferva*. After a short time, the outer wall (the mother cell of all these enclosed cells) dissolves in the water, and either suddenly vanishes in its whole circumference or its solution proceeds from one extremity and advances throughout its entire extent, when all the enclosed corpuscles, previously recognizable only by the flattening of their contiguous walls, project more or less above the surface of the conglomeration, and, expanding continually, at last burst and suddenly disappear.

The phenomena are different when the section of the *Alga* is effected in a solution of gum arabic instead of under water. Then, as the fluid penetrates into the cut Algal cell, no green cells, and scarcely any but perfectly limpid cells, make their appearance; and these present a more deceptive resemblance to drops than even in water. They may be seen to exude in succession from the interior of the *Conferva* joint-cell in great abundance and of very various dimensions, and, as they approach the aperture, to increase in size, and soon entirely stop it up. Sometimes they are coated with a green slime; sometimes this is collected into a larger mass, which is surrounded by the transparent cells, and in which they are imbedded.

On gradually adding water to the solution of gum, these hyaline cells, usually called vacuoles, are seen to swell up gradually until they collapse suddenly, when their contents mix with the water, and their membrane shrivels up, but for the most part is not dissolved. The green mucilaginous masses likewise now begin to swell, and it can be distinctly perceived that these are the vesicles filled with green mucus which collapsed in the solution of gum, whilst their membranes enveloping the green slime are now again distended in the water.

The membranes of the cells filled with a colourless strongly endosmotic fluid, which have burst in the water, may be treated with corrosive reagents without being immediately dissolved.

On submitting them to an aqueous or alcoholic solution of iodine, it is found that that reagent does not perceptibly colour either the contents or the membrane of these cells. The same holds true, in the main, when the solution of chloride of zinc

and iodine is employed, when the shrivelled membrane is scarcely coloured pale yellow.

Moreover these phenomena are modified not only by the stage of development of the plant, but probably also by variations in the conditions of nutrition, as the researches on *Spirogyra*, hereafter to be described, have further shown.

From the foregoing remarks it follows that the joint-cells of *Cladophora glomerata* do not contain at all periods of their development a mucilaginous, granular, viscid fluid—the “gonimical contents” of Kützing or the “protoplasm” of Mohl; but that, at certain periods, they are entirely filled, as if occupied by a perfect cellular tissue, with thin-walled strongly diosmotic cells, which, on the one hand, enlarge in water with extraordinary rapidity, and, on the other, shrivel up in solution of gum.

The nature of these endogenous cells is twofold. Thus some of them contain, besides a colourless watery fluid, often also without this, a larger or smaller quantity of a green mucilaginous matter (both materials being very probably enveloped in special cell-membranes), and, floating freely in the latter substance, either small vesicles of starch and chlorophyll (the latter frequently containing a starchy nuclear vesicle) or smaller and larger cells, in which these bodies are then contained. Their membrane is distended, and soon becomes liquefied in water.

The cells of the second description are filled only with a clear transparent liquid, and very rapidly absorb water until they are burst and destroyed by it. They are therefore difficult of observation, unless the water is duly mixed with gum, so as to retard the distention of the diosmotic membrane, when it becomes possible at times to demonstrate that the membrane of many of these cells is corroded, but not dissolved, by water and solution of chloride of zinc and iodine.

Between these two kinds of cells intermediate forms occur, showing that the two forms are not of an entirely different nature, but only different stages of development of one and the same kind of cell.

The phenomena observed during the action of fluids on the cut joint-cells and on the expanding endogenous cells which issue from them, as also the position of the latter in the uninjured and normally grown joint-cells, indicate that the cells consisting of watery contents and more resistant membranes occupy the median line of the cylindrical joint-cell of the *Conferva*, whilst those filled with chlorophyll, and whose membranes are soluble in water, occur nearer to the surface than this central tissue.

Moreover, at the extremities of the joint-cells of perfectly normally developed plants, the limpid cells—pressed together

until they assume polyhedral forms, which occupy the central space of the joint-cells—are seen (as in fig. 31 α) pushing forwards beneath the cells filled with chlorophyll which occur on the surface.

During the period of the multiplication of the joint-cells, either the larger of these endogenous cells filled with secretory matter are, as it would seem, entirely absent, or else those are chiefly present which enclose in their readily soluble membranes the smaller ones containing chlorophyll and starch. These can then only be recognized in the vicinity of large endogenous cells which are no doubt developed into new joint-cells.

The relative proportion in which these two forms of endogenous cells are present, and their consequent position in the joint-cell of the *Confervæ*, cause the wide range in form which prevails in these plants.

As the mode of development and distribution of the endogenous cells is dependent upon the nutrition of the plant, and consequently upon the chemical composition of the fluid in which it grows, the cultivation of *Cladophora glomerata* will furnish important materials for a revision of the systematic value of those forms.

The great tendency to the diffusion of fluid which the transparent cells exhibit causes these cells, when the uninjured plant is placed in a solution of tannic acid, to expand greatly and to become visible on the surface after some time has been allowed for the reagent to act. This reagent will frequently bring to light the presence of cells within joint-cells, even although before quite invisible, the whole substance looking like an unorganised mucilage. This is well seen in the case of the colourless contents of the joint-cells of *Mougeotia*, in the median line of which the single mass of chlorophyll appears to float freely, surrounded by a colourless homogeneous fluid. This latter, however, is found to consist of a mass of closely placed, rather elongated, or often somewhat cubical cells, by the expansion of which in a spiral direction the twisted form which the chlorophyll often exhibits is produced.

These cells likewise usually become very distinct in the joint-cells undergoing enlargement alongside wounded joint-cells, after they have remained for some time in pure water, and thus give the surface of the plant a largely cellular reticulate aspect.

In Pl. VI. fig. 89, an instance is figured of the expansion of one of these endogenous cells to half the dimensions of the joint-cell, without having new cells formed within its cavity.

The great delicacy of the walls of the endogenously stratified (nested) system of these cells is an obstacle to the recognition of the plan of their arrangement and of the course of their de-

velopment in uninjured plants; whilst their extreme fragility when separated from their organic connexions renders it impossible to ascertain, with regard to the tissue-cells, whether the binary combination obtains with them as the external phenomena of development render probable.

It would appear, as before observed, that the cells filled with colourless fluid occupy the median space of the joint-cell, and that, towards the outside, these pass into the series containing chlorophyll, probably becoming converted into them. This mode of development would not be in favour of the prevalence of the binary type, if we did not know that most of these cells only exercise the function of secretion-cells, and that they become overgrown (that is to say, pushed aside and dissolved) by one or more cells becoming developed into tissue-cells: first their proper membrane, then the nitrogenous vesicle enveloped by them, and finally the secretion-vesicles, rich in carbonaceous compounds, are absorbed.

In a thick-walled form of *Cladophora*, I repeatedly observed (Vegetationsorgane der Palmen, 1847, p. 80) that, in somewhat diseased cells, a number of these endogenous thin-walled cells containing chlorophyll acquired walls as thick as those of the joint-cell itself; and in *Cladophora glomerata* small interposed joints are not unfrequently met with (as shown in fig. 80 a), which I look upon as separated secretion-cells which have exceptionally acquired thick walls and passed into the series of tissue-cells, instead of having been absorbed by the vegetation-cells in course of normal development.

In diseased and withering joint-cells of *Confervaceæ* we frequently meet with individual examples of these endogenous cells, which contain only starch or are completely empty.

§ V.

Mode of development of the radical extremity of the cell of *Cladophora*.—

Formation of folds in the coats of the adjoining withered cells.—Joint-cells of the root-cell.—Independent growth of their cell-membrane.—Folds in the assimilating membrane of the joint-cell, and their causes.

During the previously described downward growth of the joint-cell of *Cladophora*, not only its proper membrane, so far as this forms a septum, but also the immediately contiguous wall of the neighbouring cell, extends itself in the direction of the cut surface. The latter is seen thrust backward within its own cavity as the former is extended into this (Pl. VI. figs. 81 & 83). Very soon, however, this backward-pushed wall of the cut cell, which is at first somewhat swollen and thickened, as in the uninjured condition, becomes lost to view at the extremity of the advancing growth from the neighbouring cell (figs. 85, 87, 88,

& 39). It is only at the spot where it formed an annular fold, in consequence of its depression, that it is any longer visible, very strongly thickened, often in layers.

In the course of the further development and outgrowth of the adjoining living cell, this membrane of the inverted cell, which thus serves the living cell as an external envelope comparable to a *cuticle*, is absorbed in the same way as the intermediate substance and cortical tissue which is dissipated before an adventitious root. (See my account of the Organs of Vegetation of the Palms, pl. 4. fig. 8.)

This absorption of the inverted septum (figs. 37, 38, 39, & 42 *a*, *b*) proceeds from below upwards (from the centre towards the periphery), in such a manner that the rather thick fold is, at a certain phase of development, the sole indication of the displaced septal wall; it then surrounds and somewhat constricts the daughter cell, in the form of an annular fibre, within the enveloping membrane (fig. 42 *a*; the immediately preceding stage of this fold is represented at *b*).

This structural condition occurs not only in the course of artificial preparations, but also very frequently as a consequence of injuries in the course of the natural growth of the plant. These annular folds, when their origin is not recognized, may easily be mistaken for those others which have been regarded as incipient and suppressed septal structures.

The remaining cylindrical dead wall of the cut joint-cell sometimes presents a delicate, though very definite, longitudinal striation (figs. 31, 33, 35).

Not unfrequently, moreover, a cell is prolonged, in the manner described, through two or more adjoining cells, on account of circumstances operating prejudicially on their vitality; and we then find on the surface of these long joint-cells several annular folds situated at distances determined by the length of the original cells.

It is the general, but not universal rule, that the development of isolated joint-cells proceeds in the manner illustrated in figs. 33, 34, & 35, the adjoining dead cell-wall being regularly and equally invaded by the growing cell, and apparently expanded passively. At times one side or one portion of the septum appears to offer greater resistance than the rest, or else the vegetative energy of the extending cell is more considerable on one side than in the median line; and the consequence is the production of irregular forms of the annular rings, as exhibited in figs. 37 & 39 *a*.

It also now and then happens that the growing cell, when it has just advanced into the cavity of the cut cell, does not thrust the whole area of the septum downwards before it, but, as shown

in figs. 36 & 38, only the central and less thickened or entirely unthickened portion of it, inflating it at first in a globular form, and subsequently occupying more or less completely the entire space of the lower cell.

In the normally developing septum the increase of volume of the assimilating and growing cell-membrane (fig. 40 *a*), which manifests itself as a thickening, commences at the periphery, and advances hence in the cylindrical part of the membrane towards the ends of the two cells, in accordance with the growth of their mother cell; in the septum itself the advance is towards its central point.

If, by the stronger endosmotic distention of the neighbouring uninjured cells, a greater pressure is exerted, soon after the cutting of the cell, upon a septum of this kind which has not long become liquefied, the septum is not grown through as above described, but it is suddenly ruptured, and the contents of the neighbouring and previously uninjured cells are pressed out through the opening.

A similar laceration of the new septal wall and escape of the contents of a cell into the neighbouring cells, after the operation of endosmotic fluids, takes place also in uninjured cells, and appears to have furnished earlier investigators with support for the idea of a septal formation by the growing in of a fold of the parietal part of the membrane of the mother cell as far as its middle line.

Sometimes the downward-growing lower end of the upper cell does not thrust the transverse wall before it in the median line, but to one side, so that its lengthening extremity presents on one side a very narrow, and on the opposite a much wider, annular fold as the remnant of the original septal wall (figs. 37 & 39 *a*).

I have more frequently observed instances where the downward growing cell has not prolonged itself within the next dead or cut cell beneath, but has thrust this entirely to one side, so that the two cells appear in apposition, longitudinally, like two wedges lying in opposite directions.

Sometimes connected *Conferva*-filaments are met with in which some single cell has become diseased and withered, and then the immediately superior cell has grown in the form of a root-cell into the cavity of the diseased cell, down to its bottom, forming the next lower septum. This portion which has grown down then begins to enlarge, until it entirely fills the cavity of the diseased cell, and its lower extremity forms a perfectly normal septum with the neighbouring cell.

The very long joint-cells thus formed become, just as in the case of the root-like cells produced from injured *Conferva*-cells,

subsequently divided into joints (sections) by the formation of endogenous cells.

The first indication of young joint-cells in the root-cells, both in their extreme points immediately within the enveloping membrane (fig. 32) and in the interior of the joint-cells already present, consists in the appearance of a continually enlarging cell, which at first shimmers through the chlorophyll, but afterwards becomes free in its median part by the displacement of the chlorophyll, and exhibits in its interior small vesicles, the rudiments of new cells. I have not completely traced in one and the same root-cell the entire absorption of the chlorophyll, starch, &c. which at first separate the daughter cells of the second order; but I have seen, in different individuals, all the transition-forms up to states in which there were no longer any organized bodies between the two new joint-cells of the root-cell, but only an apparently gelatinous, unorganized, intercellular substance, as represented in fig. 32.

The membrane of the endogenous cells of the root-cell always appears to be thicker at the lower than at the upper end; therefore where two cells are in immediate contact, the portion of the lower cell entering into the structure of the septum is easily overlooked, especially as it is here not only a very thin membrane, but also somewhat thrust backward by the convex extremity of the contiguous thickened cell.

At the extremities of the stem and of the branches the opposite conditions are met with. We indeed equally find at times the contents of the last joint-cells composed of several thin-walled cells, as seen in Pl. VI. fig. 42 *a*, where the contents are distinctly divided into three segments, each enclosed by a delicate membrane. The upper extremity of the lowest cell here projects somewhat within the lower and concave end of that next above it; consequently the septa of these young cells (discoverable with the greatest difficulty) are not flat, but conical. The uppermost little cell discernible at the summit of a branch is filled with vesicles as yet scarcely coloured green. Similar vesicles are found at the extreme ends of root-cells; this serves to contradict the erroneous supposition that this *Alga* has no terminal growth. I have also observed a similar phenomenon in *Vaucheria* (*op. cit.* p. 90, pl. 2. fig. 2).

The apex of the root-cell, which is usually thinner (fig. 42) and ramified at its extreme end, where it is adherent to other bodies, generally of organic nature (figs. 43 & 44), shows a very remarkable independence in the growth of its outermost cell-membrane, which encloses the whole root just as the cuticle does the up-growing stem. This cell-membrane, independently of that of the enclosed cells, emits branches which become much

thickened, frequently in layers (fig. 45), just as the cuticle is nodosely thickened sometimes in the same plant at the apices of the branches, and, in phanerogamous plants, frequently above each epidermal cell, apparently independently of the contents of the latter.

An independent growth similar to this of the cuticle, which grows out into knots, folds, and branches, is exhibited by the membranes of the joint-cells of *Cladophora glomerata*, which form inwardly annular folds, sometimes presenting a great resemblance to those already described as produced in consequence of penetration (figs. 38, 39); nevertheless they are readily distinguished, by the disposition of their parietal prolongations, from the latter, which are quite different from them.

The origin of these folds (fig. 40 *b*) of the integument of the secondary cells was observed both simultaneously with the commencing thickening of the membranes of the endogenous joint-cells, which come into contact in the normal septum (fig. 40 *a*), and also in those cells not undergoing the act of multiplication.

After the thickening and the chemical transformations associated with it have commenced in the cell-membrane, a progressive increase in thickness, but no elongation, is to be seen in these folds. Not unfrequently they encroach so far into the cavity of the cell as almost to reach the median line and nearly to divide the constricted cell-contents; nevertheless the still existing connexion between the two segments of the cell thus drawn apart continues unchanged.

Contemporaneously with the thickening in the membranes, there appears to exist in these cells, as long as this formation of folds is taking place, a tendency to expansion, the volume of the mother cell and enveloping membrane remaining the same, by which means the expanding daughter cell is compelled to grow into the cell-cavity in the form of a fold: this also occurs in the septa of many *Spirogyra*.

The cause of the production of these folds of endogenous cells appears therefore different in nature from that which separates the daughter cells of the root-cell from one another (fig. 32).

The mother cell of the root-cell develops its membrane (cuticle) (which, as it were, takes on the function of the spongioles of vascular plants) predominantly in proportion as the included daughter cells expand themselves; whilst in the production of folds in the cells of the stem and branches the membranes of the daughter cells especially become enlarged, and are in this way productive of the folds, different forms of which occur in the other Confervaceæ.

The joint-cells engaged in this process of fold-construction (fig. 40 *b*) always seem to exercise a certain degree of pressure

upon the neighbouring cells, which involves some impediment to their extension.

In the normal production of septa (fig. 40 *a*) no such tension exists in the subdividing cell.

Mohl, indeed, observed these folds, which he represented as originating in a disturbance of the process of constriction of the primordial utricle during continuous formation of membrane. Mohl saw these structures in specimens of *Cladophora glomerata* that had been kept for some time in fresh water.

I likewise found these folds frequently in cultivated specimens of this plant, but have no explanation to offer respecting the special cause of their production. In a specimen of *C. glomerata* which has been growing for a year in a very small vessel filled with distilled water, both these folds and septa of the normal form occur; and indeed the latter are the more frequent. In various other specimens, however, preserved also for a long time, though not so long as the former, in river-water, in plants covered with Desmidiæ, the normal septal development rarely occurs; still the multiplication of joint-cells has proceeded in these plants, though their differences in length are very marked.

The production of folds has here (fig. 40 *b*) occurred very largely, and in all forms; so that the idea suggested is that these inwardly growing folds are the commencement of septa. Still this is not the fact; for, as before stated, the folds, when once formed, undergo no ulterior change.

§ VI.

Formation of septa in the joint-cells of *Cladophora* by means of endogenous cells. The cell-membrane is rendered thicker in the vicinity of the annular folds by superposition.—Thickening of the membrane, in the absence of annular folds, by the superposition of extremely thin-walled cells.—Means of separating the superimposed cells of the thickened cell-wall by diosmotic fluids.—Action of these reagents upon new joint-cells.

In many stages of development of these infolded *Cladophora*-cells, we may convince ourselves, by slight pressure exercised upon a joint-cell engaged in the act of folding (as, for instance, during the gradual drying-up of the surrounding water, or during the sudden accession of fresh water in place of that which has been withdrawn), that its contents on either side of the fold are in direct communication, and traverse freely from one part to the other, which is not the case when a true septum is produced.

This phenomenon shows that no actual, complete septum, however delicate, is ever established in connexion with this fold; and it also indicates that the secretion-cells, which usually occupy the joint-cells, had here probably terminated their cycle of de-

velopment, and left only their final and most highly developed products, in the shape of small vesicles freely moving within the juices of the cell, and destined for the nutrition of new joint-cells.

If such joint-cells, furnished with annular folds (fig. 40 b), be examined for some time, progressive, though very gradual, changes are observed to take place in the position of the secretion-vesicles. Here and there in the vicinity of the annular fold the sharp outline of a cell, apparently filled with colourless fluid, will make its appearance among the mass of secretion-material which occupies the joint-cell. This enlarges, and progressively advances towards the middle line of the fold. A similar process may be frequently witnessed going on simultaneously on the other side of the fold.

Lastly, the entire and somewhat rounded end of the cell may be observed free from chlorophyll close to the fold; the membrane, as compared with that of other young cells, is thick, but of a gelatinous aspect, whilst the contiguous thick membrane of the fold resembles that of woody tissue.

The two endogenous cells at last approach so closely together in the middle line of the fold, that, by their mutual pressure, they form a septum which, to those who have not followed its development, would appear as if it had been forcibly separated at its periphery by the annular fold.

In other cases, a cell arises on one side only of the fold, and continues to elongate itself beyond this, until it reaches the next septum.

The membrane of the fold appears, during the subsequent existence of the endogenous cells, to become absorbed; for we find that where these latter have thick walls, the former is thinner than when those cells were newly formed.

This mode of formation of septa by tolerably thick-walled endogenous cells, readily observable during their slow growth, is, however, of comparatively rare occurrence in *Cladophora glomerata*. Usually, in this plant, the commencement of thickening first calls attention to a pre-existent and fully developed although very delicate septum, this having been previously concealed from observation by the great quantity of secretion-materials with which it is covered.

In my account of the structure of *Vaucheria*, I showed that this so-called unicellular plant consisted of a composite system of endogenous cells, the innermost of which develop themselves and enclose organized secretory materials simultaneously with the absorption of the mother cells with their contents, but that the membranes of all these joint-cells do not become thickened and therefore may easily be overlooked.

In *Cladophora glomerata*, whose endogenous cells have just been considered, a thickening of the originally very delicate membrane of certain endogenous cells occurs regularly, but only when these have acquired their normal size and by their contact and pressure concur in the formation of a transverse septum whilst, at the same time, the secretion-cells in their vicinity undergo absorption.

The more rarely occurring conditions of development described in the last section seem to me also to elucidate sufficiently the normal process, the essential relations of which can with difficulty be followed in the joint-cells when completely filled with chlorophyll and other secretion-materials.

Fig. 46 shows one of the joint-cells of *Cladophora* poor in chlorophyll and filled with the large colourless cells, such as are produced by cultivation in pure distilled water, especially when the plant has been cut into short pieces. The specimen has been subjected for a short time to the action of dilute glycerine, in order to detach the endogenous cells from the membrane of the mother cell. The membranes of these cells, though separated by a delicate septum, were not perceptibly thickened; by the action of exosmose they were contracted and also detached from each other at the septum (x), without leaving a layer of deposit between them. This happens also in the case of *Oedogonium*, as above described (p. 283), but appears to be of unusual occurrence.

The conviction is thus arrived at of the actual presence of free cells and of the origin of a septum by the mutual contact of their walls, even before any appreciable thickening, and without the agency of any involution or folding of the mother cell. Nägeli, indeed, noticed these phenomena, but nevertheless believed in the existence of inward-growing walls, which might be invisible either on account of their tenuity or of their containing a great amount of water.

One of the two thin-walled daughter cells represented in fig. 46 is seen at q to be again divided by a distinguishable septum, in all respects similar to the septum displayed in *Oedogonium*, as observed at its origin and represented in figs. 21-29, and described at p. 277. This delicate septum would not be distinguishable if the inner wall of the mother cell were, as usual, coated with secretion-vesicles, until these were absorbed, and the later process of thickening set up in it. In the present case, the observation of this young joint-cell, which had been rapidly expanded in consequence of the injury done to the neighbouring cells, was rendered possible by the less degree of aggregation of the secretion-materials.

The cells that make their appearance on the section of a joint-

cell of *C. glomerata* render it highly probable that these septa originate from the mutual contact of endogenous cells, just as is observed in the above-described annular folds and in *Cedogonium*, and that the septum which gradually becomes visible through the dense layer of chlorophyll, extending from the periphery to the centre of the joint-cell, is not then for the first time produced, but that its becoming visible only indicates the increasing thickness of the walls of the cells concerned in its formation by their apposition, just as has been fully described in *Cedogonium*.

In *Cedogonium* it may be distinctly demonstrated that the absorption of the secretion-matter contained in the cells in process of multiplication does not take place until after the enlargement of the endogenous daughter cells, and subsequently to the construction of the septum by their contact.

In *C. glomerata*, in the course of normal septum-formation (fig. 40 a), the largest portion of the secretion-matter situated externally to the two enlarging new joint-cells undergoes more or less complete absorption when these endogenous cells have so far advanced in growth as to constitute a new septum by the apposition of their walls, the nitrogenous compounds being the first to dissolve.

The absorption of the secretion-materials contained in the mother cell is concurrent with a new formation of them within the young joint-cells; therefore in *Cedogonium* this new production only takes place after the completion of the septum, whilst in *Cladophora*, on the contrary, it happens simultaneously with, or even before, this period.

If sulphuric acid, or a solution of chloride of zinc or of chloride of calcium, be allowed to act for some time upon a specimen of *Cladophora glomerata*, and a solution of iodine be then applied to it, a cloudy violet-coloured slimy layer, looking like finely divided iodide of starch, makes its appearance between the primary and secondary cells, resembling the lamina sometimes observed in the same locality in *Cedogonium* (p. 282) after the simple application of a solution of iodine to its tissues. Whether this material is the remains of the secretion-matter, as in *Cedogonium*, or is analogous to those other conditions to be discussed in *Spirogyra*, are questions requiring further research to answer them.

The examination of *Vaucheria* convinced me that the cell developed as a branch is formed within the stem-cell, and only projects from the surface simultaneously with the production of a branch-like process from the enveloping membrane. The same fact may be observed also in certain stages of the development of *C. glomerata*. The septum produced by the enlargement of two endogenous cells is not completed and does not become thickened

before one of the two cells has extended itself more or less completely from the cylindrical cavity of the mother cell in the form of a branch. It might be imagined that it is so forced out by the contemporaneous predominant growth of the sister cell. This regular course of branch-formation is not, however, always thoroughly carried out; the lower extremity of the branch-cell frequently remains within the mother cell, and aids to form along with its sister cell a septum in the form of an oblique or horizontal thickened lamina.

The externally visible phenomena which accompany the processes of normal septum-formation in *C. glomerata* may readily mislead one into regarding the explanation given of them by Mohl as the natural one.

Having, however, ascertained that in the joint-cells of *C. glomerata* there is generally concealed beneath the superficial layer of secretion-cells a complete tissue of endogenous cell-systems—a tissue which certainly does not cohere, like the cellular tissue of more highly organized plants, by intercellular substance, or at least not by such as is insoluble in water and which consists, not of persistent tissue-cells, but almost entirely of transitory secretion-cells (for large mother cells may be seen, filled with cells of nearly half the size of a joint-cell, to swell forth from the cut joint of the Conferva),—having ascertained that the flat horizontal septum produced by the mutual apposition of these endogenous cells occurs already formed (fig. 46 *g*) in the secondary cell before this has become thickened, and having been able in certain cases, by means of endosmotic fluids, to divide this septum and to recognize its composition out of parts of two neighbouring cells (fig. 46 *x*),—having, further, even in *C. glomerata*, exceptionally seen septa normally formed by the mutual apposition of two cells originally separate (p. 419, fig. 32) and even belonging to different generations,—we shall feel called upon to submit the normal process of septum-formation in this plant to another examination in order to try to refer it to the general law of cell-formation.

Fig. 40 *a* (Pl. VI.) exhibits the phenomenon first witnessed by Dumortier (Nova Act. Leop.-Carol. 1832) and described in detail by Mohl, which is regarded by him and his followers as a folding of the walls of the joint-cells of *C. glomerata* in process of multiplication, and as the type of “cell-formation by fission.”

Mohl (Vermischte Schriften, 1845, p. 623; Veget. Zell. 1851, p. 212; Botanische Zeitung, 1855, p. 689) supposed that the internal surface of the secondary cell (primordial layer) is overlaid with a granular mucoid protoplasm, the chlorophyll-layer, which gives way at the same time or nearly so that the involution (fold) of the walls, formed by the primordial layer and the youngest

lamina of deposit (thickening layer), advances into the cavity of the cell and unites at its centre.

Between the secondary cell and the chlorophyll-layer a colourless mucous fluid collects during this process. This fluid is held by Dippel (*Vegetabilische Zellenbildung*, 1858, p. 32) to be plasma, which originates in this situation on account of the active generation of tissue going on in it, and which forces the green contents towards the interior as a consequence of its accumulation. Not unfrequently, when this plasma is first seen, there is no perceptible trace of the septum, which subsequently makes its appearance, commencing from the periphery in such a manner that, as it has been described, it seems to be a product of crystallization. But that the delicate walls of the daughter cells may be here actually present, though hidden in the mucoid plasma, the previously recorded action of solution of tannin upon the mucous contents of the cells of *Mougeotia* afford sufficient evidence.

Concurrently with the first indications of the presence of a septum (at times, indeed, previously), the mass of chlorophyll recedes towards the middle line of the cell: it seems as if the green contents were separated all round by the colourless plasma and on each side by the narrow lamina from the neighbouring walls of the joint-cell, and pressed towards the middle line of the latter,—not divided, but for the present constricted (fig. 40).

In this case, however, the constriction or compression of the chlorophyll-mass is only apparent; for a closer examination of this condition shows that the vesicles which form the chlorophyll-layer do not actually withdraw, but have become colourless in the spot occupied by them, whilst the adjoining septum makes its appearance more distinctly. Sometimes a green vesicle remains somewhat longer in the colourless mass, and may be distinctly seen to grow progressively more and more colourless.

The mode of deposition of the elongated starch- and chlorophyll-vesicles in the so-called constriction (fig. 40 *a*) often gives rise to an appearance as if these corpuscles were deposited on the wall of a tube, continually constricted at that part, and particularly so in the last stages of thickening of the septum, where they stand at right angles to it; nevertheless it may be observed, especially in wide cells, that here also at their centre there exists a lighter cavity elongated in the direction of the septum which is undergoing alteration,—a cylindrical body, a cell which exerts its influence upon the deposition of the chlorophyll during absorption.

However, this arrangement of the secretion-vesicles is liable to very great variation: the condition represented in fig. 40 *a*, and previously described, is very often met with; frequently, in

this stage, no chlorophyll-vesicles are to be seen outside the endogenous cell undergoing enlargement; but almost as often secretion-vesicles are distinctly visible in abundance externally to the central cell which has been arrested in its development, and not uncommonly so dispersed and irregularly arranged and mingled among the colourless and distended vesicles, that the impression, at first sight, is that they are not enclosed within a special membrane.

It would appear that the secretory material of the chlorophyll-layer in process of absorption serves, on the one hand, for the thickening, and on the other for the enlargement, of the neighbouring cell-walls (p. 427).

The nature of the cell which probably exists in the interior, and becomes enlarged simultaneously with the thickening of the septum, has not been ascertained.

Conditions like that shown in fig. 46 *g* render it probable that the next younger pair of joint-cells is already developed and undergoes division in the cavity of the joint-cell that is just making its appearance, from the walls of which they are separated only by a small quantity of chlorophyll and starch-vesicles, which are subsequently dissolved gradually.

In the unthickened septum itself, even when it is visible in this state, as in the example represented in fig. 46 *g*, it is very seldom that, with the reagents hitherto employed, the two cell-membranes of which it was composed (fig. 46 *x*) can be demonstrated. Still less can it be decided by observation whether the membrane of these cells in this stage of development belongs to two cells nested one within the other.

Those septa, on the other hand, in which thickening has commenced are capable, in proportion to the extent to which this process has advanced, of being resolved into the different cell-membranes of which they are composed by the action both of endosmotic fluids and of solvents of the recently thickened membrane.

Transitory endosmotic phenomena are produced in many *Conferva*-cells even by the action of different kinds of water met with naturally, such as spring-, river-, or rain-water, and indeed sometimes by pure distilled water in the case of plants previously grown in other water. Water containing carbonic acid, and other mineral waters, are more energetic.

The action of concentrated carbonic-acid water upon many *Confervaceæ* (for instance, on *Spirogyra*) is of a complex nature; for, besides diosmosis, a change in the constitution of the cell-membrane takes place: in this plant it causes a swelling up of the young, and an increase of the ligneous condition of the older, cell-membranes.

Endosmotic fluids of more potency, saline solutions, acids, sugar, alcohol, &c., which detach the several adherent membranes of the superposed cells from one another, have an exosmotic as well as an endosmotic action.

Hence the membranes of the secondary cells become contracted and separated from the primary cells with which they were previously in immediate contact, by the action of these reagents; and indeed they detach themselves all round from the external membrane, the separation of these membranes of the two cells not being perfect until the chemical change has commenced but not been completed in one wall. In this case, the membranes continue united where the thickening of the contiguous primary cell-walls has not yet taken place. In the transverse walls or septa this happens, therefore, at the centre, inasmuch as their lignification advances from the periphery, or centripetally. The young joint-cells consequently continue to adhere closely together, apparently wedged into the central opening of the perforated discoid septum, as is exhibited in the case of *Spirogyra*, in Plate VII. fig. 67.

This phenomenon has especially contributed to support the notion that the adjoining daughter cells constituted originally only one single cell, which has become divided by the thickened portion of the septum.

In *Edogonium* we may convince ourselves, by direct observation, that, notwithstanding these results with reagents, which might serve as arguments for the constriction-theory, there is present a perfect, though it may be an extremely delicate, septum.

The delusion is still greater if, in this condition (fig. 67), a pressure from one side be exercised on the young septum (whether effected by the one-sided operation of endosmotic fluids or by a change of tension caused by the cutting of a cell in the immediate vicinity of the septum), and chemical reagents be then applied to dissolve the cell-membrane which is undergoing a change in its chemical constitution.

That many newly formed cell-membranes, or such as are in course of development, are soluble in water, and still more readily in acetic acid, I have already shown in my above-mentioned memoir on *Conferva fontinalis*. The cell-membrane, in process of thickening, which occupies the central layer of the septum, is dissolved by ammonia and iodine as well as by acetic acid.

Of the above-mentioned solvents of the newly thickened cell-membrane, ammonia appears to have the weakest action; its effect, however, is probably the less striking because it acts endosmotically, and not exosmotically, upon the contents of the secondary daughter cells. However, after the operation of am-

monia on the septum, when in course of thickening, and while apparently still simple, the limits of the two daughter cells forming it are distinctly seen; in other words, its construction out of two lamellæ is demonstrated. Iodine, when applied in a concentrated state, has a more energetic solvent action upon the recently thickened primary cell-membrane; and when its solution is diluted, it is at the same time exosmotic in its action on the contents of the secondary cells.

If these solvents be allowed to act for a time upon half-lignified septa, the different component cell-membranes of which have been separated from each other as much as possible by means of diosmotic fluids, the newly lignified septum thus set free is eroded at the centre, and finally more or less dissolved, whilst the two contracted and mutually adherent daughter cells float freely in the cavity of the parent cell. Examples such as that represented in fig. 67, of a *Spirogyra* treated with glycerine and afterwards with a solution of iodine, should therefore be cautiously used in elucidation of the mode of origin of a septum.

In this experiment it now and then happens that one young joint-cell (as shown in Pl. VII. fig. 67) which is adherent by one extremity to its neighbouring sister cell, and with it detached on every side from the mother cell, is at the same time still attached to the opposite end of its mother cell, by which a considerable tension of the young cell in its long diameter is produced, and being transferred to the neighbouring septum, is exerted chiefly on the delicate young wall in process of lignification. This is consequently somewhat drawn into the cavity of the extended cell until it becomes lacerated at its point of union with it, whereupon it again assumes its flat form, and the second daughter cell is drawn through the circular central opening so formed in the septum into the adjoining cell-cavity.

At times the lignified portion of the septum is so delicate that, after the operation of a solution of glycerine, only a very slender annular thread is visible on the inner surface of the mother cell; and it might be supposed that the two adherent contracted secondary daughter cells floated freely in the centre of the mother cell. Upon the addition of a diluted watery solution of iodine, which is greedily taken up by the fluid contents of the primary cell, it is perceived, by the movements thereby induced within the two contracted and coherent daughter cells, that these do not float freely in the centre, but are fixed in their position by the thread-like annular septum, which, from the cloudiness of the cell-fluid, caused by the solution of iodine, appears like an extremely thin clear lamina, and exhibits slight movements corresponding with those of the daughter cells.

The constricted line of union between the two connected daughter cells is not unfrequently colourless; nevertheless it cannot be positively ascertained whether, as appears upon altering the focal distance, and as would correspond with my notion of the origin of the septum, the circularly torn thickened septum is continued as a delicate membrane throughout this uniting band, or whether a fluid constitutes the stratum of separation between the coloured secretion-matter contained in the two daughter cells.

In most instances, even this connective band is concealed by the coloured contents, which are pressed into the median line by the contracted membranes of the secondary cells; and in these circumstances the scar of the lacerated septum exhibits the appearance of a notch in this lamina in the mass of chlorophyll.

The appearances in cells where new septa are in course of lignification are altogether different when rather stronger diosmotic agents are brought into contact with them. In such cases one of the young joint-cells is frequently more strongly contracted than its neighbour; the delicate septum perceptible between them, which usually, in its youngest and unthickened condition, protrudes in a convex form into the upper cell (Pl. VI. fig. 42 *a*), does so, under the condition in question, to a greater degree; the contiguous secretion-vesicles likewise gradually recede into the less extended cell, until at length the septum can no longer withstand the constantly increasing pressure, but gives way before it, and allows a sudden rush of the chlorophyll- and starch-corpuscles from their cavity into the neighbouring one. These phenomena may be readily witnessed in the vicinity of the cut portions of the joint-cells (p. 421).

This translation of the chlorophyll- and starch-corpuscles from one side of the septum to the other, within the expanding cell, and which may especially be seen for a considerable time after the rupture of the septum, might lead those who do not take into consideration the great extensibility of the unthickened cell-wall, and who may not have observed the ultimate rupture of the young septum, to the erroneous belief that no septum existed betwixt the two closely approximated and contracted daughter cells.

However, if, after extension has proceeded for a time, the abrupt and forcible movement of the chlorophyll-vesicles, &c. be first observed, followed by a more gentle one, the operation of diosmosis remaining unchanged, no other inference can be drawn than that an existing obstacle has been suddenly removed, and evidence thereby afforded of the previous existence of a septum, overlaid by those secretion-vesicles, at the spot where the movement occurred.

When the above-mentioned solvents for a cell-membrane engaged in chemical metamorphosis for the purpose of lignification are allowed to act upon a septum in process of thickening (fig. 40 a), and a stronger contraction is then induced in one of the two adjoining and adherent daughter cells by the agency of exosmotic fluids, the central and unthickened portion of the septum is torn through, whilst the peripheral walls of the two adherent sister cells remain connected, as indeed was observed although differently interpreted by Mohl (Vermischte Schriften, xiii. 8, 9).

The chemical and physical actions of the above-mentioned commonly employed reagents upon the substance of plants has, however, been by no means sufficiently studied to enable us, from the changes which they produce upon vegetable tissues, to arrive at any certain conclusions as to the structure of the latter. And our knowledge of the mode of action of these reagents upon the membranes of assimilant cells is especially imperfect, because it is different in each new stage of development of the cell, which is in a constant process of change.

The intimate knowledge of the anatomical changes which take place in the cell in the course of development must therefore precede, or at least go hand in hand with, that investigation, the results of which consequently, as yet, are of subordinate value in the appreciation of anatomical conditions.

The mutual adherence of the constituent cell-membranes of the septum (p. 283), which stands so much in the way of a correct recognition of its true nature, appears to be still more inexplicable, under certain circumstances, in fully developed cells. In such cells the still delicate daughter cells are commonly separated with great facility from the parent cell by the action of diosmotic fluids. But if a specimen of *Conferva glomerata* be allowed to lie for some time in a dilute aqueous solution of tannin or of ammonia, and an aqueous solution of iodine be then brought in contact with it, not only are the membranes of the secondary cells loosened from those of the primary, but these last also are partially separated from the mother cell, and the enveloping membrane from the included joint-cells even to the very extremity (fig. 41). All the thickened membranes moreover show very clearly the thickening layers, which are either imperceptible or very imperfectly recognizable in the living plant: this is the case especially after their penetration by a solution of gum arabic. The delicate membranes of the secondary cells are not, however, detached at both extremities, as in normal states, from the primary cell, but maintain their position as exhibited in fig. 47; and as they become contracted by exosmosis, they drag the primary membrane, which lies

loosely in its mother cell, after them at both ends, so that the surfaces formed by the septum occur at the base of the retracted extremities of the sac.

This condition consequently shows that, though the two cells concerned in the construction of a septum may, as a rule, not be recognizable prior to its thickening, there is no cause to doubt the presence of those membranes, which is indeed justly deduced from other circumstances.

The stronger cohesion of the two cell-membranes at their extremities indicates a dissimilar chemical constitution in their different regions—a circumstance that also obtains among some cells of the complex tissues of more highly organized plants.

From all the foregoing facts it follows without doubt, that the folds of the joint-cells of *Conferva glomerata*, so far as they can be certainly recognized, have no connexion with the multiplication of cells by fission, and indeed exert no demonstrable direct influence upon cell-multiplication. On the contrary, it has been ascertained that, in *Cladophora*, in certain cases, the septa originate by the growth and mutual contact of the membranes of free endogenous cells; and upon this ground we may perhaps be justified in explaining, by analogy with other instances, the process of normal septum-formation in this plant, which, on account of peculiar complications, cannot generally be recognized with the same distinctness.

[To be continued.]

XLI.—*Notice of the Capture of Mithras paradoxus in England.*

By JOHN BLACKWALL, F.L.S.

IN the 'Annals and Magazine of Natural History' (ser. 3. vol. ix. p. 375), I have stated my belief that, on a careful inspection of *Mithras paradoxus*, it would be found to be provided with four pairs of spinners, and a calamistrum situated on the superior surface of the metatarsus of each posterior leg. An opportunity of establishing the accuracy of this opinion has recently been supplied by my friend Mr. R. H. Meade, who kindly forwarded to me a fine specimen of an adult female of this species that had been taken in the lake district of Cumberland, in the summer of 1863. The capture of this spider, which is now first recorded as indigenous to Britain, is a circumstance of peculiar interest; for, having placed beyond all doubt the fact that it possesses eight spinners and calamistra, every difficulty that has hitherto been experienced relative to assigning it an appropriate position in the systematic arrangement of the *Araneidea* is thereby removed. By its well-marked organic characters, it is

evident that *Mithras paradoxus*, together with its congeners *M. flavidus* and *M. dubius*, should occupy a place in the family *Ciniflonidae*, immediately after the genus *Veleda*.

The foregoing discovery necessitates a modification, as subjoined, of the characteristics of the

Genus MITHRAS.

Eyes eight, unequal in size, and disposed on the sides and anterior part of the cephalothorax in two transverse, curved rows; those of the posterior row, which is much the longer, and has its convexity directed forwards, are larger than those of the anterior row, the lateral eyes, which are seated on bold conical tubercles, being rather the largest; the eyes of the anterior row, whose convexity is directed upwards, are situated above the prominent frontal margin; the two intermediate ones are placed near to each other on a minute tubercle, and the lateral ones are not very conspicuous, being the smallest and lightest-coloured of the eight; the lateral eyes of both rows are separated by a wide interval.

Maxilla short, straight, powerful, and greatly enlarged at the extremity.

Lip triangular or somewhat oval.

Legs robust, of variable relative length in different species, each metatarsus of the posterior pair having a calamistrum on its superior surface.

Spinners eight; those of the inferior pair, which are the shortest, consist of a single joint each, and are united throughout their entire length.

BIBLIOGRAPHICAL NOTICE.

An Elementary Text-book of the Microscope; including a description of the Methods of preparing and mounting Objects, &c. By J. W. GRIFFITH, M.D., F.L.S. 12mo. Van Voorst, London, 1864.

NOTWITHSTANDING the numerous books of various kinds which have been published as guides in the employment of the microscope, Dr. Griffith appears to us to have justly come to the conclusion that there was room for one more; and the mode of treatment which he has adopted in the little work now before us places it, in some respects at least, not only apart from, but in a superior position to most of its predecessors and competitors. It is, in fact, rather as an elementary course of microscopic research than as a 'Text-book of the Microscope' that we welcome its appearance, by far the greater portion of its pages being devoted to the description of the most characteristic objects for microscopic examination derived from the animal and vegetable kingdoms. By a judicious arrangement of

his materials, and a careful selection of examples, Dr. Griffith has rendered his work at once a manual of vegetable and animal anatomy and physiology and a guide to the general classification of organized bodies; and there is no doubt that the student who will take it as a guide, and, in accordance with the author's evident intention, work carefully through the series of easily obtained examples of animal and vegetable structures described in it, will find himself, at the end of his course of study, already in possession of a very considerable amount of information, and quite prepared to follow out any particular line of investigation upon his own account. It is, indeed, manifestly with a view to the latter point that Dr. Griffith has prepared this Text-book, and in this he seems to us to have been eminently successful: we are acquainted with no work so well adapted to set the reader in the way of independent microscopic research. The amount of valuable information compressed into the pages of this little volume is perfectly astonishing, as is also the quantity of beautiful and characteristic coloured figures which the author has succeeded in bringing together in the twelve plates with which the work is illustrated.

To the practical consideration of the microscope itself Dr. Griffith does not devote much space, and he altogether avoids the discussion of the comparative merits of different makers and of different modes of construction, confining himself to a brief description of the essential structure of the instrument and of the uses of its different parts. In his concluding chapter, however, he enters upon the consideration of the scientific principles involved in the construction of the microscope, including the phenomena of refraction and reflexion, the nature and effects of lenses, achromatism, and polarization of light; and we have seldom, if ever, seen these somewhat difficult matters so simply and perspicuously treated.

With regard to the preparation and mounting of microscopic objects, special details are scattered throughout the work, indicating the particular treatment best adapted for the successful preservation of certain groups of objects—the general plans to be adopted in any case being very shortly and simply described in the second chapter. Small as is the space devoted to this important subject, the methods recommended (which indeed are those most commonly in use among microscopists) are thoroughly well described; and perhaps it is better for the beginner to have one good set of methods laid before him, than to be left to select those which may hit his fancy from a collection of all the processes adopted by various microscopists.

MISCELLANEOUS.

Dredgings in the Freshwater Lakes of Norway.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,—I believe the following extract from Mr. G. O. Sars's account (given in the 'Nyt Magazin,' Christiania, for 1862) of his dredgings in some of the freshwater lakes of Norway has not ap-

peared in English. I send it to you as being likely to interest naturalists in this country.

35 Royal Terrace, Edinburgh.
April 22, 1864.

I am, yours faithfully,
ROBERT B. WATSON.

The dredgings were made in a little freshwater loch in the island of Christiansund, in Norway, by G. O. Sars, son of Professor Sars. The loch is fed from a peat-moss. In the deeper parts of the loch were found great numbers of *Diaptomus Castor*, of a blue colour, along with *Daphnella brachyura*, *Polyphemus Pediculus*, and a species of *Bosmina* (*B. obtusirostris*). Near the shore, among grass and Nymphæas, were *Sida crystallina* and two *Lynceides*, with numerous examples of *Acantholeberis curvirostris*.

He then says that from the deepest part of the loch he got up some of the mud, and adds, "I found this, to my astonishment, full of a small red Copepode, in which I at once recognized the salt-water species *Harpacticus chelifer* described by Lilljeborg. The presence of this Copepode was so unexpected that, in spite of the freshwater forms which I had found, I was obliged to satisfy myself by tasting the water, to be sure it was not brackish. It was perfectly fresh and pleasant to the taste.

"We thus have here, though on a different scale, an interesting analogy to what has quite recently been observed in some of the great inland lakes, such as the Venern and Vettern*, in Sweden,—viz. that true inhabitants of the sea can, in certain circumstances, gradually accustom themselves to live in thoroughly fresh water. Here, however, the agency of change has not been great, alterations of physical conditions operating throughout thousands of years. The time in this instance has been much shorter. Apparently some very high flood or a furious storm from the west has driven the sea up on some occasion into the loch, which lies close to the coast. Other salt-water species have probably been carried into the loch at the same time, and perished by degrees as the water lost its saltiness, while this little Copepode alone was able to survive after every trace of salt had disappeared. It is also interesting to observe the influence which its residence in a foreign medium has had on its mode of life. While, in ordinary circumstances, it is almost exclusively to be found in the very shallowest pools, I found it here, as I have said, in the deepest part of the water, sunk in the mud; and the same is the case with many of the salt-water forms found in the inland lakes of Sweden (such as *Idothea entomon*, *Gammarus loricatus*, *Pontoporeia affinis*). This fact seems to indicate a certain tendency in these forms, when cut off from their proper habitat, to keep themselves isolated from the true freshwater Crustaceans."

Further on, in dredging the Mjösen Lake, one of the very largest in Norway, through which flows an immense river, he says:—

"But my most interesting discovery here was a Crustacean which

* See Lovén, on certain Crustaceans found in the Lakes Venern and Vettern, 'Öfversigt af Vetenskabens Akademiens Förhandlingar' for 1861.

belongs exclusively to the salt water, *Mysis relicta* of Lovén, one of those extraordinary relics of the glacial period whose presence in some of the great inland lakes of Sweden has lately excited so much interest. I found it in small numbers at Stigersand, below Skreifjeld, in from 8-10 fathoms, just in the corner where a sandbank slopes steeply up from the deeper water beyond.

"Associated with it, I found numerous examples of a species of *Gammarus* which at the very first glance differed markedly from the form I had previously noticed, and which seems to be the *Gammarus cancelloides* of Gerstfeldt, which was first discovered in the Seas of Baikal and of Angara, and which has lately been also found in Sweden, and which Lovén likewise considers originally to have belonged to the sea."

On the Expulsion of the Carbonic Acid from the Blood during Respiration. By DR. LUDWIG.

As less carbonic acid is present in arterial than in venous blood, the elimination of this carbonic acid during respiration must be ascribed either to the oxygen or to the tissue of the lungs. For the decision of this question a series of experiments was undertaken, in which this gas was collected from unaltered venous blood, and also from venous blood which had been agitated with air containing oxygen. The blood agitated with oxygen was found to have lost its carbonic acid to such an extent that its amount of this gas was only equal to that contained in arterial blood. There is consequently no reason for regarding the pulmonary tissue as the cause of the evolution of carbonic acid.

When the unaltered venous blood was left for twenty-four hours in ice-cold water and then analysed, it appeared that in this case also the amount of carbonic acid was diminished. The same process therefore takes place in blood poor in oxygen as in that which contains oxygen in abundance, but with this difference, that what takes place very completely and in a short time in blood rich in oxygen is effected very gradually in that which is poor in that element.

To determine whether the evolution of carbonic acid is effected directly by the oxygen, or only by the intervention of the blood-corpuscles, the purest possible serum, which, as is well known, contains much carbonic acid, was employed—and, for the sake of comparison, both unaltered serum and such as had been agitated with oxygen. In these experiments the same quantity of combined carbonic acid was found in every case, and consequently only that portion of the oxygen which has passed into the corpuscles acts in the evolution of carbonic acid.

As arterial blood may thus be prepared artificially from venous blood, it was natural to try whether the reverse of this process could be effected. This, however, appears to be impossible. For when the oxygen was pumped out of arterial blood and replaced by a quantity of carbonic acid equal to that which usually occurs in venous blood, the amount of combined carbonic acid in the blood could not be increased. Hence it follows that carbonic acid is furnished in the

combined form by the tissues which prepare venous blood. This fact also leads to certain conclusions as to the manner in which the carbonic acid is combined in the blood and expelled by the corpuscles.

When the blood is completely deprived of gas, a portion of its disks is decomposed into a colourless stroma and a coloured fluid. The same phenomenon is observed, although in a less degree, when only the oxygen is removed from the blood, whether by pumping or by suffocation. On the other hand, the attempt to render the blood perfectly free from carbonic acid by the introduction of oxygen was unsuccessful. Even after the long-continued action of air containing oxygen, but free from carbonic acid, about 4 volumes per cent. of carbonic acid always remain, and these can only be got rid of after the removal of the oxygen. Blood so treated showed no changed corpuscles.—*Sitzungsber. der kais. Akad. der Wiss. in Wien*, 8 January, 1864, p. 3.

“New Forms of Mollusks?”

To the Editors of the *Annals and Magazine of Natural History*.

GENTLEMEN,—May I be permitted, as a constant reader of your excellent Magazine, to record my humble protest against the unscientific practice (now very much on the increase) of describing, in portentous detail, varieties of well-known species of shells as “New Forms of Mollusks?” I ought not, perhaps, to cavil at Dr. P. P. Carpenter giving the new name of *Callista pollicaris* to a shell which I had minutely examined and declared to be a variety of *Dione prora* (*Callista prora*, Carpenter), because it involves a question of opinion; but I may be allowed to object to his printing, as a statement of my views, a hasty conversational concurrence with an opinion to which, when I came to print my monograph, I refrained from giving publicity. What can be the object of describing as a new species a shell which the describer, in the same sentence, denotes as being probably not a new species? Dr. P. P. Carpenter brought me some shells, showing that he had named them *Callista puella*. I told him that they were simply varieties of *Dione pannosa* (*Callista pannosa*, Carpenter). But his name of *puella* was not then published: it appears in your last Number (p. 312), printed thus:—“*Callista* (? *pannosa*) *puella*.” Dr. P. P. Carpenter gives the shell a new name while at the same time denoting his fear that it may be a variety of one named already; and he goes on to remark, with reference to some white specimens of it, “The colourless subtrigonal shells were regarded by Mr. Reeve as a separate species, but he did not allude to them in his monograph.” The reason of my not alluding to them is obvious. Should even the soft parts of the shells under consideration ever come into Dr. P. P. Carpenter’s hands, I venture to predict that he will find difficulty in showing them to be “New Forms of Mollusks.”

I am, Gentlemen,

Your obedient Servant,

LOVELL REEVE.

Sutton, Hounslow,
April 7, 1863.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 78. JUNE 1864.

XLII.—*On the Classification of the Cyclostomacea of Eastern Asia.* By WILLIAM T. BLANFORD, A.R.S.M., F.G.S.

THE most generally received system of classification for the various forms of operculated land-shells is, I believe, that of Dr. Pfeiffer, as amended in the supplement, published in 1858, to his invaluable work, the 'Monographia Pneumonopomorum viventium.' The additions which have since been made to the genera belonging to the group in most cases fall naturally into the several divisions proposed.

My own observations have been limited to the land-shells inhabiting India and Burma; but a close comparison of a large number of these, together with the examination, in many genera, of the animals, has induced me to believe that several slight alterations and one or two important changes are requisite in Dr. Pfeiffer's classification, in order to bring it into accordance with the natural affinities of the forms included. I propose, therefore, in the present paper, briefly to review the various admitted genera and subgenera, to propose a few additions, and to add some remarks upon the distribution and mutual affinities of several of the species.

Too much stress appears to me to have been placed upon the structure of the operculum. In some instances the characters of genera, or even of subfamilies, mainly based upon this portion of the animal, only apply to a minority of the species or genera included. So long as an examination of the animal was impracticable, it was only natural that much importance should be attached to the structure of the operculum; and doubtless it is in general a valuable indication of the affinities of different species. But there are many cases in which its structure alone is insufficient to establish the relations of the animal. One remarkable instance may be quoted: *Cyclostoma semistriatum*, Sow., and *C. filocinctum*, Bens., both have a concentric, multispiral, *Ann. & Mag. N. Hist. Ser. 3. Vol. xiii.* 29

and duplex operculum, horny internally and testaceous externally, with a raised, shelly, lamellar edge to the whorls, the only essential distinction being in the degree of development of that lamellar edge. These two species were both classed with *Cyclotus*; yet, as I shall have occasion to show, they really belong to distinct families.

Dr. Pfeiffer's classification is the following, the Eastern genera alone being enumerated :—

Order PNEUMONOPOMA.

Suborder *Opisthophthalma*.

Family I. *Aciculidæ*. (*Truncatella*.)

Fam. II. *Diplommatinidæ*. (*Diplommatina*, ?*Paxillus*.)

Suborder *Ectophthalma*.

Family I. *Cyclostomidæ*.

Subfamily 1. *CYCLOTINÆ*. (*Cyclotus*, *Opisthoporus*, *Pterocyclos*, *Alycæus*.)

Subfam. 2. *CYCLOPHORINÆ*. (*Aulopoma*, *Cyclophorus*, *Leptopoma*, *Dermatocera*.)

Subfam. 3. *PUPININÆ*. (*Megalomastoma*, *Cataulus*, *Raphaulus*, *Streptaulus*, *Pupinella*, *Pupina*, *Registoma*, *Callia*.)

Subfam. 4. *LICININÆ*. (*No Asiatic representatives*.)

Subfam. 5. *CYCLOSTOMINÆ*. (*Otopoma*, *Cyclostomus**)

Subfam. 6. *CISTULINÆ*. (*No Asiatic representatives*.)

Subfam. 7. *POMATIASINÆ*. (*Pomatias*.)

Subfam. 8. *REALINÆ*. (*Hydrocena*.)

Family II. *Helicinidæ*†. (*Helicina*.)

Of the above genera, those in italics are not known to occur within the area to which the following remarks especially apply. This area comprises Hindustan, with the Himalayas, Ceylon, Assam, and the Burmese provinces, both British and independent.

The additional genera to which I shall refer are *Opisthostoma*, H. Blanf., *Spiraculum*, Pearson, *Rhiostoma*, Bens., *Clostophis*, Bens., *Hybocystis*, Bens., *Cyathopoma*, W. Blanf., *Jerdonia*, W. Blanf., and one or two new generic or subgeneric groups.

The principal amendments which I shall propose are in the

* *C. trochlea*, Bens., was assigned to this genus by Dr. Pfeiffer, but in error. The restricted genus *Cyclostoma* or *Cyclostomus* is really without Asiatic representatives.

† Dr. Pfeiffer's terminations for the names of families and subfamilies are rather different. I have preferred using those commonly employed in English works.

position of *Diplommata*, of all the *Cyclotina*, and of the Indian forms ascribed to *Hydrocena*.

1. TRUNCATELLA, Risso.

Only a single species of this genus (*T. Ceylanica*, Pfr.) is known to inhabit Ceylon, and none have as yet been met with elsewhere in India. The species, so far as I am aware, presents no peculiarities.

2. DIPLOMMATINA, Bens.

Dr. Pfeiffer, in his monograph, placed this genus between *Alycaeus* and *Megalomastoma*; in the Supplement, he makes it the type of a totally distinct family, of the suborder *Opisthophthalma*, which is characterized by the eyes being placed above the base of the tentacles. I have never seen living specimens of any of the *Aciculidæ*; but, judging from the plates in Adams's 'Gen. Rec. Moll.,' the position of the eyes is very similar to that seen in the *Auriculacea*. This is by no means the case in *Diplommata*, in which genus the eyes, although higher in position than in other Cyclostomaceous genera, are rather at the side of the head than above it; and there is no trace of the long proboscis of *Truncatella*. The operculum also is concentric and horny; but, from the minute size of the species, and the manner in which the operculum is withdrawn far within the shell, it is, in most cases, difficult to examine it. In some species, as in *D. Nilgirica*, W. & H. Blanf., the spiral structure is obsolete.

The Indian *Diplommata* may be divided into two groups, with distinct geographical distribution. The more numerous type inhabits the Eastern Himalayas and Burma, and comprises the following species:—

- D. pachycheilus*, Bens. Sikkim.
- D. pullula*, Bens. Sikkim.
- D. Blanfordiana*, Bens. Sikkim.
- D. diplocheilus*, Bens. Khasi Hills.
- D. polypleuris*, Bens. Khasi Hills.
- D. exilis*, W. Blanf. Ava.
- D. Pappensis*, W. Blanf. Ava.
- D. sperata*, W. Blanf. Pegu;

and two other species from Pegu as yet undescribed. These are all characterized by a continuous peristome (the upper portion being broadly appressed on the penultimate whorl), the presence of a columellar tooth, and by strong transverse (vertical) costulation on the whorls. The antepenultimate whorl is far broader than the rest, and the spire above it is more or less acuminate.

The two species from the peninsula of India described by my brother and myself, viz. *D. Nilgirica* from the Nilgiri Hills, and

D. Kingiana from the Kolamully Hills, are distinguished by their cylindrically-ovate form, smooth whorls, continuous circular peristome not expanded into a callus upon the penultimate whorl, by the absence of a columellar tooth, and by the regular convexity of the sides of the spire. The earliest described species, *D. folliculus*, Bens., and its congeners in the Western Himalayas, *D. costulata*, Bens., and the sinistral *D. Huttoni*, Pfr., are to some extent intermediate between the two types; but they approach less nearly, in their costulated whorls, more acuminate spire, and less circular mouth, to the Peninsular forms than to those of the Eastern Himalaya*.

I have lately found, in the Western Ghats near Bombay, a very peculiar minute species, belonging to the Peninsular type, but distinguished from every other form in the genus by possessing spiral sculpture.

3. OPISTHOSTOMA, H. Blanf.

Since the discovery of the minute *O. Nilgircum*, described by my brother, Mr. H. F. Blanford, in the 'Journal of the Asiatic Society of Bengal' for 1860, no additional form of this most remarkable genus has been met with, nor do any more specimens appear to have been collected.

In the 'Malakozologische Blätter' for the present year (p. 39), Dr. Dohrn, reviewing our papers, considers this form as probably belonging to the *Pupinidæ*, and remarks especially on its resemblance to the Philippine *Arinia*. This tends to confirm our belief in its Cyclostomaceous affinities, of which, indeed, there can be little doubt; but the position of *Arinia* itself is far from being satisfactorily determined, and it is classed by many writers (e. g. Pfeiffer and Adams) with *Diplommatina*. It appears probable that, in all the characters which tend to connect *Opisthostoma* with *Arinia*, the former shell approaches equally to certain forms of *Diplommatina*, partly to the Indian forms, and also in some respects to the sinistral group of Australia. In its costulation and minute size, *Opisthostoma* certainly approaches *Diplommatina*, and differs from the *Pupinidæ*, which are mostly characterized by the absence of sculpture. The last whorl in many species of *Diplommatina* rises so far in front of the shell as almost to touch the antepenultimate; so that it is easy to understand the connexion with the singular distortion of the last whorl of *Opisthostoma*, which, on the other hand, has nothing approaching to the peculiar slits and tubes characterizing the aperture of most of the *Pupinidæ*.

* This is by no means the only instance in which the land-shells of the Western Himalaya are more nearly allied to those of India proper than are the species inhabiting the same mountains further east.

Mr. Benson suggested to us, some years since, that the cause of our being unable to detect the operculum in the perfectly fresh specimens obtained was, that it was retracted far within the aperture as in *Diplommatina*. Taking all the characters into consideration, there appears good reason to believe that this genus must be classed as an abnormal member of the *Diplommatina* group.

4. CLOSTOPHIS, Bens.

A single specimen of this genus, in which the last whorl descends freely, was obtained by Mr. Benson from Molmain. I have never had an opportunity of seeing the specimen, and know it by the description alone. Judging from that, and taking into consideration the abnormal character of the last whorl, which appears to present in its peculiarities the converse of *Opisthostoma*, there appears reason to believe that this minute form will also prove to belong to the *Diplommatina* group.

Doubtless numerous species of these very minute genera have escaped the notice of collectors; for, unless most careful and special search is made for them, they will certainly remain unobserved, more especially if large and handsome forms occur in the same locality, and attract attention.

Subfamily CYCLOTINÆ.

I have long had reason to doubt the correctness of uniting the genera *Cyclotus*, *Pterocyclos*, and *Alycaeus* into one subfamily. The Indian forms of the first genus always appeared to me to possess a considerable resemblance to *Cyclostoma* and *Otopoma*. *Pterocyclos*, on the other hand, is very closely allied to *Cyclophorus*; while *Alycaeus* has no close affinity with any other genus, but appears to possess some slight points of agreement with certain Pupininae. The characters of the subfamily, moreover, as given by Dr. Pfeiffer, derived from the operculum alone, are only applicable to some of the genera included. These characters are:—"Operculum crassum, e duabus laminis compositum (exteriore plerumque calcareo, interiore cornea, ambabus sulco marginali separatis) orbiculare, arctispirum, nucleo centrali." Now the operculum in all the species of *Alycaeus* which I have examined (twenty at least) is thin, composed of a single lamina, and without any marginal sulcation. In *Pterocyclos* there is no duplication nor marginal sulcation; and the operculum in many species (e. g. *P. Cumingi*, Pfr., *P. rupestris*, B.,) cannot be said to be orbicular. For these several reasons I believe that the genera united under this subfamily must be redistributed.

5. *Cyclotus*, Guilding.

To this genus five Indian species have been referred, viz. :—

C. semistriatus, Sow.

C. subdiscoideus, Sow.

C. spurcus, Grat.

C. montanus, Pfr.

C. filocinctus, Bens.

The last I shall refer to presently as the type of the genus *Cyathopoma*. With *C. spurcus* and *C. montanus* I am unacquainted. I have a large number of specimens of *C. subdiscoideus*, from Orissa, and *C. semistriatus*, from Poona, lying before me, and I am unable to observe any constant character by which they can be distinguished,—the slight expansion of the peristome occurring in specimens of both, and the spiral sculpture and height of spire being to some extent variable characters. My specimens do not suffice to prove an absolute passage, although they indicate its probability.

I have referred to the resemblance of the shells of these species to certain forms of *Cyclostoma*; but the concentric character of the operculum would have induced me to class them with *Cyclophorus*; and I was somewhat surprised, on examining the animal of *C. semistriatus*, to find that it possessed the long looping muzzle, longitudinally cleft foot, and peculiar mode of reptation of *Cyclostoma* (e. g. *C. elegans*). There can therefore be no longer any doubt that this species and its allies must be classed near *Otopoma*; and the question arises whether the whole of the forms arranged by Dr. Pfeiffer and others in the genus *Cyclotus* have similar affinities. I suspect not. The genus may be divided into several sections, which I will briefly note.

I. The American species, which have little in common with those of Asia and the Asiatic islands, but which, probably, like *C. semistriatus*, should be classed with *Cyclostoma*. They have been distinguished as *Aperostoma* and *Cyrtotoma*. I am not aware if the animals of these shells have been examined; but it is not very probable that either they or the American forms ascribed to *Cyclophorus* and *Megalomastoma* are really congeneric with the oriental species. They more probably represent them, just as the *Sesara* section of *Nanina* does the *Tridopsis* division of *Helix*, the shells in this case being so similar that they would certainly be classed together but for essential distinctions in the animal.

II. *C. filocinctus* and its allies.

III. The typical forms. The types of the genus *Cyclotus*, as established by Swainson, are stated by Pfeiffer (Mon. Pneum.

Viv. p. 16)* to be *C. variegatus*, Swains., and *C. planorbulus*, Lam., both from the Philippines. These shells possess a closely wound, thick operculum, membranaceous internally and subtestaceous without, very similar indeed to that of *Opisthoporus*, except that the latter is hollow within—a distinction the importance of which may be over-estimated. There is a deep sulcation round the margin, and considerable concavity externally. The shell is smooth or nearly so, very depressed, subdiscoidal, with a thick epidermis, and is generally precisely similar to the discoidal forms of *Cyclophorus* (e. g. *C. stenostomus*, Sow.), and especially to certain Burmese species (as *C. calyx*, Bens.), to which the *Cycloti* are doubtless very closely allied. The other Philippine species (*C. mucronatus*, Sow., *C. pusillus*, Sow., *C. scalaris*, Pfr., *C. substriatus*, Sow.) will be classed in the restricted genus, which doubtless comprises also the three Chinese species, as well as those of Cochinchina, Java, Borneo, &c., and several from the Moluccas, lately described by Dr. von Martens in the 'Malakoz. Blätter.' The nearest allies of the genus thus restricted being apparently amongst the species of *Cyclophorus*, *Cyclotus* must be referred to the same subfamily as that genus.

IV. *C. Macgillivrayi*, Pfr., from the New Hebrides, may very possibly be a depressed form of the type for which Dr. Gould has proposed the generic name *Ostodes*. The operculum is subtestaceous, but otherwise in no respect different from that of some *Cyclophori*. *C. daucinus*, Pfr., and *C. Recluzianus*, Pfr., from the Solomon Islands, may be related; but these species are only known to me by description.

V. Omitting a few dubious species, there only remain the four Indian forms, and *C. conoideus*, Pfr., from the Seychelles and Mauritius, which very probably belongs to the same type as *C. semistriatus*. These species are nearly affined to *Lithidion*, but differ in their concentric operculum, and, being well distinguished from all known genera, must be classed by themselves. I propose to call them

CYCLOTOPSIS, n. g.

Testa late umbilicata, depressa v. turbinato-depressa, spiraliter lirata; apertura subcirculari. Operculum concentricum, multispirum, duplex, interne membranaceum, externe testaceum, marginibus anfractuum externis elevatis.

Animal *Cyclostomatis*, haud *Cyclophori*.

Type, *C. semistriatus*, Sow.

This genus will be classed as a subgenus of *Cyclostoma* by all who consider *Otopoma* and *Lithidion* as such. It may, as above suggested, be related to *Aperostoma*. In the raised margins of

* I have not access to the original work at present.

the whorls of the operculum there is some resemblance to the West-Indian *Choanopoma*; but the shells are very different. It forms an additional link between the Indian fauna and that of Africa and South-western Asia*.

6. JERDONIA, W. Blanf.

Testa umbilicata, pyramidata, cornea. Operc. concentricum, arctispirum, sulco marginali circumdatum, duplex; interne membranaceum, externe testaceum, et ex anfractibus vittæformibus compositum, quoque proximi interioris marginem externum tegente.

Type, *J. trochlea*, Bens., sp.

Although I proposed this genus two years ago (Journ. Asiat. Soc. Bengal for 1861, vol. xxx. p. 351), I have never published the characters in full. The species upon which it is founded is a peculiar minute, pyramidal, horny, tricarinated shell inhabiting the Nilgiri Hills, and which, in the absence of the operculum, was referred by Dr. Pfeiffer (Mon. Pneum. Viv. Supplement, p. 116) to *Cyclostoma*. The operculum I obtained in 1859, and it proved to have the peculiar structure described above†. It bears no inconsiderable resemblance to that of *Cyclotus variegatus*, Sw., differing mainly in the inner edge of each whorl resting upon the outer edge of the next, whereas in *Cyclotus*, and in general throughout the *Cyclophoridae*, the reverse is seen.

The position of this peculiar shell is still somewhat obscure; but as the operculum is, despite its singular structure, more nearly allied to that of *Cyclotus* than to any other, it may, in default of a knowledge of the animal, be classed with the *Cyclophorinae*, and may possibly be related to the next genus.

In the paper above referred to as published in the 'Journ. Asiat. Soc. of Bengal,' I was disposed to refer a second species, from the Kolamully Hills of South India to this genus. Further examination of this form, the operculum and animal of

* Throughout the fauna of the Indian peninsula there is a blending of Africano-Asiatic and of Malayan forms. In the Mammalia, amongst the Carnivora are found species of the African Lion and Hyæna, and the Caucasian Wolf, Fox, and Jackal, with the Malayan Tiger, Paradoxure, &c.; and in the Ruminantia, the African types in the Indian forms of Antelope, with the Malayan Rusa- and Axis-deer and *Bos gaurus*. Amongst the birds the same is seen,—species of the Malayan Jungle-fowl and Peacock co-existing with those of the African Sand-grouse and *Francois*. In the land-shells, Malayan types of *Nanina*, *Cyclophorus*, &c., accompany African forms of *Bulimus*, *Otopoma*, &c. As might be expected, the African representatives predominate in the west of the peninsula, Malayan in the east; and the former frequently occur on the plains, the latter on the hills, the fauna of which often resembles the Malayan types of the Himalayas.

† It is figured in the illustrations to the paper in the 'Journ. As. Soc. Bengal' above referred to.

which are unknown, induces me to class it with *Cyathopoma*. It is probable, however, that, as in other cases, representative forms of *Jerdonia* may hereafter be found on the other hill-groups of the Indian peninsula or of Ceylon.

7. CYATHOPOMA, W. Blanf.

Testa umbilicata, turbinata v. turbinato-depressa, epidermide crassa, sæpe hispidula induta, plerumque spiraliter lirata. Operculum truncate conoideum, concentricum, multispirum, e duabus laminis compositum; interna membranacea, externa testacea perconcava; anfractuum marginibus externis in lamellam testaceam, versus medium incurvatam, interdum pulchre sculptam, elevatis.

Animal *Cyclophori*.

Type, *C. filocinctum*, Bens., sp.

The forms comprised in this genus of minute shells (the largest known is only 3 millimetres in diameter) are all peculiar to the hills of the Indian peninsula. Two, belonging to distinct sections, have been found on the Nilgiris, one on the Kalryenmully Hills, near Salem, and a fourth on the Western Ghats, near Bombay. A somewhat similar form has lately been found in the Andaman Islands by Mr. Theobald, who has kindly sent me a specimen. It differs, however, in several minor characters of the shell, and in wanting the very peculiar operculum of *Cyathopoma*, and appears more nearly allied to a section of *Cyclophorus* peculiar, so far as is known, to Burma.

The animal of *Cyathopoma* is white, with a short oval foot, undivided beneath, and has small black tentacles, with eyes at the base.

The known species are the following:—

1. Spirally lirata.

C. filocinctum, Bens.

C. Kalryenense, H. Blanf.

C. —, n. sp. (undescribed). Western Ghats near Bombay.

2. Smooth.

C. Malabaricum, W. Blanf. Nilgiri Hills.

C. Kolamulliense, W. Blanf. Kolamully Hills.

8. PTEROCYCLOS, Bens.

This is one of the best-marked types of the Cyclophoroid group, so far as regards its Indian (and typical) representatives; but, in Burma, it passes almost imperceptibly into forms of *Cyclophorus*. I have alluded in a previous paper (Ann. & Mag. Nat. Hist. for July 1863) to the relations of the incision in the inner and cowl-shaped process of the outer lip of the peristome

to the tubes in other genera of the *Cyclophoridae*. There can be no doubt that the "wing" in *Pterocyclos* is a rudimentary tube, although no portion of the animal has been observed to correspond with it.

The species of this genus may well be distinguished into two sections.

1st. Those inhabiting the Indian peninsula and Ceylon, viz.:—

P. rupestris, Bens. Bengal, Behar, Orissa.

*P. bilabiatu*s, Bens. Hills of South India (base).

P. nanus, Bens. Nilgiri Hills.

*P. Cumingi**, Pfr. Ceylon.

These are all characterized by their very convex opercula.

2nd. The Burmese forms—

P. parvus, Pearson. Assam and Arakan†.

P. pullatus, Bens. Pegu.

P. —, n. sp. Thayet Myo, Pegu.

Also, probably, *P. cetra*, Bens., from Molmain, and *P. Albersi*, Pfr., from the Khasi Hills. In these the operculum is nearly flat, while the wing of the peristome is much less developed than in the forms of the Indian peninsula. No species have as yet been obtained from the Himalaya. It is worthy of note that the Indian species with the least-convex operculum and smallest wing is the Nilgiri *P. nanus*, Bens., thus affording an-

* I am doubtful whether *P. Cingalensis*, Bens., be more than a variety of *P. Cumingi*, Pfr. The duplication of the peristome is frequently a character depending upon the age of the shell, which, of course, may vary in specimens collected at different periods of the year. Moreover, which of the Cingalese species is *P. Troscheli*, Bens.? Probably *P. Cumingi* or *P. bifrons*, Pfr., which may possibly be only varieties of one species. *P. Troscheli* was described from a drawing, at a time when the fauna of Ceylon was almost completely unknown. This has changed, and the land-Mollusca of Ceylon are now far better known, and have been much more largely collected than those of many parts of India; and it is very improbable that the species has been overlooked. Descriptions of species from drawings, unless those drawings have been made by persons intimately acquainted with the critical distinctions of allied species, are never satisfactory; and when, as in this case, three or four other species have been subsequently described from the same geographical area, differing from that first named and from each other in minute characters which would infallibly be overlooked by an ordinary observer, it is very improbable that all are really distinct. It is to be hoped that some of the numerous collectors of Ceylon shells may possess specimens of a *Pterocyclos* from Trincomalee, which would go far towards deciding the question.

† Specimens of a *Pterocyclos* which I found in Arakan, at Akyab, and of which a flatter variety occurred further south, near Tongooop, agree generally with the description of *P. parvus*. The operculum is plano-concave within (the central boss being very slightly prominent) and nearly flat without, with free lamellar edges to the whorls.

other instance of the affinity of the hill-fauna of Southern India to Malayan types.

9. *SPIRACULUM*, Pearson ; and 10. *OPISTHOPORUS*, Bens.

The genus *Spiraculum*, distinguished by the possession of a retroverted sutural tube open at both ends, and by a modification of the form of the mantle corresponding to the same, has, I think, better claims to generic distinction from *Pterocyclos* than even *Rhiostoma*. Its claim to separation from *Pterocyclos* I believe equal to that of *Opisthoporus* from *Cyclotus* ; and I should be inclined to class *Opisthoporus* as a subgenus of *Spiraculum*, as I have little doubt that the animal of the former genus, when examined, will be found to be similar in structure to that of the latter.

Mr. Benson has lately described, under the name of *Opisthoporus Gordoni*, a species from Molmain, in Burma, which may, I think, very possibly prove to be a *Spiraculum*, when the operculum is obtained, as the known geographical range of forms belonging to that genus approaches far nearer to Molmain than that of *Opisthoporus*. To whatever type it may belong, it serves admirably to illustrate the extremely close affinity between them, since there is no character possessed by it which may not be found in one or the other form of each genus. *S. Avatum*, W. Blanf., has a duplicate lip and a smooth surface ; while an undescribed species occurring in Assam has the last whorl free for a longer distance than in any known species of *Opisthoporus* ; and it has also a more prominent projection from the upper portion of the peristome. The sole difference between the two genera is in the structure of the operculum.

11. *RHIOSTOMA*, Bens.

The projection from the upper portion of the peristome in this species differs from that in *Spiraculum* and *Opisthoporus* in being accompanied by a deep incision in the inner peristome, clearly showing that it is the homologue of both wing and incision in *Pterocyclos*, and of both projection and sutural tube in the first-mentioned genera. In *R. Housei*, Pfr., the projection indeed forms a perfect tube. *Rhiostoma* is doubtless a good type, although species may very probably be met with connecting it with *Pterocyclos* more closely than is now the case. A single species (*R. Houghtoni*, Bens.) is found at Molmain ; all others are Malayan.

12. *AULOPOMA*, Troschel.

I have no especial remark to offer upon this genus, which has not hitherto been met with out of Ceylon.

13. CYCLOPHORUS, Montfort.

Within the area to which these observations especially apply there exist several distinct series of forms of this well-known and important genus, some of them differing from the type at least as widely as *Leptopoma* does. These should be separated as subgenera.

I. Of the several groups classed under *Cyclophorus*, one of the most distinct is that for which the following appellation was, a few years ago, suggested by Mr. Theobald. It may be thus characterized:—

LAGOCHEILUS, Theobald, MS.

Testa anguste umbilicata, turbinato-conica, parva, spiraliter lirata, epidermide fusca (in exemplis junioribus sæpe hispidula) induta. Peristoma incrassatum, superne ad angulam rima transversa breviter incisum. Operculum planum, tenue, albidum.

Type, *C. scissimargo*, Bens., from Tenasserim.

The other species (all from Burma) are

C. tomotrema, Bens. Khasi Hills.

C. —, n. sp. Pegu.

The animal of the last species has a longitudinal groove above the posterior end of the foot, somewhat as in the Auriculoid genus *Melampus*.

The shells are all about the same size as *C. halophilus*, Bens., and its allies, but easily distinguished by their thickened lip, greater solidity, and the peculiar slit at the angle of the upper margin of the peristome. To this section the little species found by Mr. Theobald in the Andamans, and previously referred to, appears to belong.

II. The next group* comprises certain discoidal shells, also Burmese, as a type of which *C. calyx*, Bens., may be selected. The operculum is thicker than in other *Cyclophori*, and has free and rough margins to its whorls, so as to be absolutely identical with that of *Pterocyclos pullatus* and its allies. In *C. calyx*, also, there is a slight expansion of the outer peristome at the suture corresponding to the wing in *Pterocyclos*. A similar slight expansion is seen in *C. phanotopicus*, Bens., from the Himalayas, which, however, has a thin operculum. I consider, therefore, that in these forms and in the Burmese species of *Pterocyclos* we have that almost complete passage from one genus into the other, to which I have already referred, and clear evidence of their close natural affinity. There can be little doubt that *Pterocyclos* belongs to the same subfamily as *Cyclophorus*;

* For this section I proposed, in a paper printed in the 'Journal of the Asiatic Society of Bengal' for 1863 (p. 322), the name *Scabrina*. Further study of the genus has led me to the conclusions expressed above.

and its associated genera, *Rhiostoma*, *Spiraculum*, &c., must fall into the same group.

This little section, the species of which also agree in their velvety epidermis, when in good condition, appears to coincide in so many points with the subgenus *Myxostoma* of Troschel, that it may probably be classed with that section. The characters of the Burmese species are

Testa late umbilicata, depressa, subdiscoidea, epidermide fusca hispidula induta; anfractibus rotundatis. Apertura circularis, peristomate incrassato. Operculum crassum, corneum, anfractuum marginibus lamellatim elevatis.

The species included are—

C. pinnulifer, Bens. Khasi Hills.

C. calyx, Bens. Molmain*.

C. hispidulus, W. Blanf. Ava.

III. The discoidal species of India and Ceylon, with thin opercula. These are—

C. phaenotopicus, Bens. Darjiling.

C. ravidus, Bens. Nilgiri Hills and Ceylon.

• *C. stenostomus*, Sow. Nilgiri Hills.

C. deplanatus, Pfr. Nilgiri Hills.

C. annulatus, Trosch. Ceylon.

C. Bairdii, Pfr. Ceylon;

and one or two Ceylonese species with which I am unacquainted. *C. Bairdii*, *C. stenostomus*, and *C. deplanatus* are so closely allied as to be scarcely more than local varieties; and the same is the case with *C. ravidus* and *C. annulatus*.

IV. A group of shells arranged by Pfeiffer under *Leptopoma*, but differing from the species of that genus in the non-expanded peristome, in the rounder whorls, more globose forms, slower increase in the size of the whorls, and consequent comparative smallness of the mouth, and in the tendency to a rapid and irregular descent of the last whorl in aged specimens. The species are peculiar to Ceylon and Southern India, and comprise the following:—

C. cæloconus, Bens. Southern India.

C. malleatus, W. Blanf. Shevroy and Nilgiri Hills.

C. halophilus, Bens. Ceylon,

C. orophilus, Bens. Ceylon;

and three or four other Ceylonese species, the differences between which and the two last mentioned are very minute.

* The locality is, I believe, erroneously given as Akoutoung, Pegu. I have collected largely and repeatedly at that locality, but never met with a specimen; whereas the shell is abundant at Molmain.

V. But a solitary species is known, of another type, as yet only found upon the Nilgiri Hills—*C. cuspidatus*, Bens. I have been enabled to examine the operculum of a specimen belonging to the Madras Museum, through the kindness of Capt. Mitchell. It differs widely from that of any *Cyclophorus*, being far more closely wound. The thick dark epidermis, forming a fringe round the carination of the last whorl, the peculiar acuminate form, and the concave sides of the spire form a combination of characters which entitle this species to at least subgeneric distinction. It may be called

CRASPEDOTROPIS, nov. subg.

Testa acuminato-conoidea, carinata, epidermide fusca crassa fimbriam carinae praebente induta. Operculum arctissime spiratum.

It is very probable that, as in the case of *Cyathopoma*, other species may be found to inhabit the other hill-groups of the peninsula or of Ceylon. Should they show no passage into *Cyclophorus*, this may fairly be ranged as a distinct genus.

VI. The typical species, e. g. *C. involvulus*, Müll., *C. Indicus*, Desh., *C. Aurora*, Bens., *C. fulguratus*, Pfr., *C. aurantiacus*, Schum., &c. These species are in many cases so variable, and at the same time are distinguished from each other by such very minute and unimportant characters, that a revision of the whole group is most desirable. I regret very much that I have not the materials at hand for the work. A very large weeding-out of dubious species and of varieties is required; but, in order that this may be effectual, access to a greater number of the types of described species than I can examine at present is requisite.

14. LEPTOPOMA, Pfr.

Omitting the Ceylonese and South-Indian group already mentioned, which certainly belongs to *Cyclophorus*, and passes through *C. caeloconus* into the depressed section of that genus comprising *C. stenostomus* and its allies (No. III. of the preceding classification), there are no *Leptopomata* described from the Indian peninsula*; but two are attributed to Ceylon, and three to Burma. The two Ceylonese species (*L. semiclausum*, Pfr., and *L. apicatum*, Bens.) I have never seen; they may be a modified form of the group of *Cyclophorus halophilus*, Bens., with thickened peristomes. They do not appear to be true *Leptopomata*. The Burmese species are

L. Cybeus, Bens. Khasi Hills.

L. Burmanum, Pfr. Tenasserim.

L. aspirans, Bens. Tenasserim.

* *L. vitreum*, Sow., is quoted from the Nilgiris; but it is very improbable that it has really been found at that locality.

Of these, *L. Cybeus* I consider a *Cyclophorus*, probably only adolescent; and my impression, derived from a comparison of the type-specimens in Mr. Theobald's cabinet, and of some fine and fresh examples of *C. zebrinus*, Bens., from the same locality, was that the former were merely a variety, perhaps immature, of the latter. I would, however, wish to repeat the observation before expressing a definite opinion, and merely suggest the idea as probable.

L. Burmanum, Pfr., I have not seen; but it also appears, from the description, to be very probably an immature *Cyclophorus*, many young shells of that genus having very thin and membranaceous opercula. In this, as in so many other cases, the characters of the operculum alone are insufficient for generic distinction.

The sole remaining species, *L. aspirans*, Bens., is a true *Leptopoma*, with the peculiar form, peristome, and texture of shell characteristic of the genus. It has a wide range, being found in the Tenasserim provinces, near Bassein in Pegu, and throughout Arakan as far north as Akyab.

It is only by confining the name *Leptopoma* to the peculiar and well-marked type, species of which are so numerous in the Indian Archipelago and the Philippine Islands, that it can be considered to have claims even to subgeneric distinction. At the best it appears to have no better claim to be separated from *Cyclophorus* than has *Myxostoma* or *Lagocheilus*; and its proper position is probably as a subgenus.

15. ALYCÆUS, Gray.

This genus was founded on a solitary species from Cochin China, and only three forms were enumerated in Dr. Pfeiffer's monograph published in 1852. In 1858 the number had increased to fourteen, almost all the additional species being from the Indian area. I now possess no less than thirty-five species, being all the described Indian forms with the exception of *A. Andamania*, Bens., and all others, so far as I am aware, except *A. gibbus*, Fér., and *A. pilula*, Gould.

The known forms from the Indian and Burmese area amount to thirty-one, of which one has not yet been described. No type in the whole order is better characterized nor more distinct from all others, no approach to a passage into any other genus being yet known. I have already referred to the broad distinction between *Alycæus* and *Cyclotus*; the former is equally distinct from *Cyclophorus*, despite the similarity of the operculum. But the singular and anomalous form of the shell induces me to believe that it can best be classed in a subfamily by itself; and this view is borne out by the peculiar texture of the shell,

by its sculpture, which is distinct in general from that of any other of the *Cyclostomacea*, except *Diplommatina*, and in the absence of any tendency to coloured zigzag markings—a character which may not appear of much value at first, but which is nevertheless singularly constant throughout the genera *Cyclophorus*, *Pterocyclos*, *Opisthoporus*, *Cyclotus*, &c.—in fact, nearly all the *Cyclophorinæ*. The animal is similar to that of *Pupina*, having short, black tentacles, and differs in no essential point from *Cyclophorus*.

The large addition to the number of species renders it possible to define more exactly the generic characters; and the following may be suggested:—

Testa perforata v. umbilicata, conica, turbinata, globosa vel depressa, unicolor, albido- v. succineo-cornea, rarius rubella. Anfractus convexi, ultimus ad latus tumidus (spatio inflato sculptura confertiore plerumque ornato), deinde prope aperturam constrictus, tubulo suturali externo, pone stricturam oriente, antice in anfractu aperto, cum spatio inflato longitudine concordante, postice clauso munitus. Peristoma circulare, plerumque incrassatum vel reflexum. Operculum corneum (rare subtestaceum?), multispirum, nucleo centrali interno prominente sæpe munitum.

In the 'Ann. & Mag. Nat. Hist.' for March 1859, Mr. Benson suggested the division of the genus into a typical section and two subgenera, which he named *Charax* and *Dioryx*, distinguishing the three sections by the characters of the constriction, the typical group embracing such species as have "the last whorl constricted somewhat remotely behind the aperture, tumid on both sides of the constriction." In the section *Charax*, the constriction is "broad, contiguous to the aperture, and divided more or less remotely from it, across the whorl, by a ridge, which is hollow internally." In *Dioryx* the constriction is "narrow and immediately behind the aperture."

This distinction appeared at the time to be good, with the exception that one of the species referred to *Dioryx* (*A. crenulatus*, Bens.) was more closely allied in most of its characters to a form of *Charax* than to the members of its own section. But there was evidently, after the removal of this species, a much closer alliance between *Charax* and the typical group than between either of those types and *Dioryx*. To this Mr. Benson referred in his paper, and also to the fact that the Western Himalayan species, *A. strangulatus*, Hutt., showed a tendency to a passage from *Charax* to the typical section. Since the publication of Mr. Benson's observations, some other species have been discovered, especially *A. Theobaldi*, W. Blanf., and *A. polygonoma*, W. Blanf., which are also intermediate in the characters of the constriction; and it may be doubted whether the form of

this one portion of the shell is sufficient for a division of the genus.

The section *Dioryx*, however, as proposed (provided the depressly turbinate and strongly sculptured species *A. crenulatus* be omitted) consists of a very natural and well-marked group of forms, all of a somewhat globose shape, with a short sudden constriction close to the peristome, and smooth (or, at the most, striated), while nearly all other species are more or less strongly costulated, at the inflated portion of the last whorl. There may perhaps be some slight affinity between these peculiar globose forms and the tubulated genera of the *Pupinæ*, especially *Raphaulus*.

The subgenus *Dioryx*, as thus defined and restricted, embraces the following species :—

A. amphora, Bens. Molmain, Burma.

A. urnula, Bens. Darjiling, Sikkim.

A. distortus, Haines. Siam and Cambodia, Himalayas.

?*A. pilula*, Gould. Hong-Kong, China;

and a fifth species from Cambodia, obtained by M. Mouhot, of which I have not learned the name.

It will be observed that this group prevails to the eastward, only one solitary representative being found on the Himalayas. Doubtless other species, in considerable numbers, of all sections of the genus *Alycaeus* may yet be found in the unexplored Malay and Chinese countries and in some of the large islands of the archipelago*.

The description of *A. pilula* is very imperfect, and I have never seen the species; but it may possibly belong to *Dioryx*, as no transverse sculpture is mentioned as occurring on the whorls. The spiral striation is peculiar.

The remaining species of *Alycaeus* are, for the most part, very difficult to distinguish by any one special character, though they may easily be grouped round different typical species. In this way we may obtain seven more or less well-marked sections, which may be briefly described.

I. Type, *A. gibbus*, Fér. Shell perforated, subpyramidal; constriction remote from the aperture; sculpture fine; sutural tube elongated.

A. gibbus, Fér. Cochin China.

A. pyramidalis, Bens. Tenasserim, Burma.

* The great proportion of large shells to small amongst the species described from the Philippine Islands, and the different ratio found elsewhere, where the minute forms have been carefully sought for, renders it probable that the Molluscan land-fauna even of those islands has only as

II. Type, *A. constrictus*, Bens. Shell perforated, ovately conical; sculpture consisting of very few ribs on the inflated portion of the shell; sutural tube very short.

A. constrictus, Bens. Darjiling.

A. bembæ, Bens. Darjiling.

A. otiphorus, Bens. Darjiling.

A. graphicus, W. Blanf. Arakan Hills, Burma.

III. Type, *A. polygonoma*, W. Blanf. Shell subturbinate, narrowly umbilicated, with the peristome more or less crenulated; sculpture fine.

A. polygonoma, W. Blanf. Arakan Hills, Pegu.

A. succineus, W. Blanf. Arakan Hills, Pegu.

A. Vulcani, W. Blanf. Puppa Hill, in the kingdom of Ava.

IV. Type, *A. crenulatus*, Bens. Shell turbinately depressed, solid, costulated.

a. Peristome fimbriated.

A. crenulatus, Bens. Darjiling.

A. plectocheilus, Bens. Darjiling.

b. Aberrant; peristome not fimbriated.

A. vestitus, W. Blanf. Arakan Hills.

V. Type, *A. sculptilis*, Bens. Shell perforated, subtrochiform, costulated, compressed at the periphery.

A. sculptilis, Bens. Pegu.

A. Rechthofeni, W. Blanf. Molmain.

A. Jagori, Von Martens. Java?

VI. Type, *A. umbonalis*, Bens. Shell depressed, solid, strongly costulated; constriction remote, simple.

A. umbonalis, Bens. Pegu.

A. Ingrami, W. Blanf. Arakan.

A. Andamania, Bens. Andaman Islands.

A. physis, Bens. Darjiling.

A. prosectus, Bens. Khasi Hills.

A. armillatus, Bens. Thayet Myo, Pegu.

A. humilis, W. Blanf. Akoutoung, Pegu.

A. —, n. sp. Arakan.

VII. Type, *A. strangulatus*, Hutt. Shell depressed or depressly turbinate, costulated; constriction broad, crossed by a ridge or swelling. (*Charax*, Bens.)

a. Ridge crossing the constriction not recurved; shell depressed.

A. strangulatus, Hutt. Western Himalayas.

yet been very partially explored. It is remarkable that Dr. von Martens should not have met with either this genus or *Diplommata* in the Moluccas.

A. expatriatus, W. Blanf. Nilgiri and Shevroy Hills, South India.

A. Footei, W. Blanf. Kolamully Hills, South India.

A. Theobaldi, W. Blanf. Khasi Hills.

A. Ava, W. Blanf. Ava.

A. styliifer, Bens. Darjiling.

A. spiracillum, A. Adams & Reeve. Borneo and Japan!

b. Ridge recurved; shell depressed, turbinate.

A. hebes, Bens. Khasi Hills.

A. gemmula, Bens. Darjiling.

A. nitidus, W. Blanf. Arakan.

It will be noticed that many of these sections are restricted in their geographical distribution.

16. RAPHAULUS, Pfr.

In a previous paper (Ann. & Mag. Nat. Hist. for July 1863, vol. xii. p. 55) I have described the peculiar structure of the animal in *R. chrysallis*, Pfr., the only Burmese species of this genus. The other two known species are from Penang and Borneo. The shell is remarkable as forming a link between the various genera of *Pupininae*. It possesses the general form of *Pupina* and *Registoma*, and the tube is the homologue of the incisions in the peristome of those species; at the same time, it resembles *Hybocystis* in the ventral flattening of the last whorl, and *Megalomastoma* and *Cataulus* in its sculpture.

17. STREPTAULUS, Bens.

This genus appears to represent, in the Himalayas of Sikkim, the *Raphauli* and *Pupinae* of Burma, Malacca, and Borneo. It was described by Mr. Benson (Ann. & Mag. Nat. Hist. for 1857, vol. xix. p. 201) as intermediate between *Raphaulus* and *Alycaeus*, on account of the characters of the sutural tube. In this view of its affinities I cannot coincide. The tube in *Streptaulus*, as in *Raphaulus*, opens inside the body-whorl, at the suture, a few millimetres within the peristome. Thence it runs internally, also as in *Raphaulus*, forwards to the aperture; and in the normal variety it passes out through the top of the lip, and runs backwards for a short distance along the suture, being open at the extremity; the external portion is somewhat irregular, thin, and liable to decay. The course is precisely similar to that in *R. chrysallis*, except that the tube, after emerging from the body-whorl, runs backwards instead of upwards. It is quite distinct from the course in *Alycaeus*, in which the tube is never internal, and is, moreover, closed externally. But this is not all: in two species of *Raphaulus* (*R. bombycinus*, Pfr., and *R. Lorraini*, Pfr.)

the tube opens externally in the peristome itself. Now, there is a small variety of *Streptaulus Blanfordi* (which perhaps has claims to specific distinction) in which precisely the same takes place, the tube not running backwards along the suture, but opening in the peristome. In no character of the shell can *Streptaulus* be considered to agree with *Alycaeus*; nor, I think, can a generic separation from *Raphaulus* be founded upon the very slight variation in the sutural tube, in the course of which there is quite as great a diversity between *R. chrysallis* and *R. bombycinus* as between either of these and *Streptaulus*; and if the distinction be preserved, it must be founded upon another character. Such a character is presented by the form of *Streptaulus*, which, in place of being flattened ventrally, and having the upper whorls distorted as in *Raphaulus*, has all regular as in *Pupina*. But I doubt if this character alone be of more than subgeneric value, and I should therefore conclude that the present type is a subgenus of *Raphaulus*, and that it tends to connect that genus, not with *Alycaeus*, but with *Pupina*.

I regret that I have not noted the animal of *Streptaulus*. It is probably similar to that of *Raphaulus*. Should the soft tube leading to the air-chamber prove to be wanting, there will be better grounds for generic distinction.

18. PUPINA, Vign.

Only four species of this form are known from Burma and the neighbouring countries, viz. :—

P. imbricifera, Bens. Khasi Hills.

P. artata, Bens. Molmain.

P. arula, Bens. Molmain.

P. Peguensis, Bens. Eastern Pegu.

P. artata also occurs in Arakan and throughout the Irrawaddy valley as far north as Ava. It is a somewhat variable shell—one variety, from the neighbourhood of Prome and Thayet Myo, being somewhat more globose than the type, and having a rich orange peristome.

No member of this genus has yet been found upon the Himalayas, where *Streptaulus* alone represents the group, the members of which diminish greatly in number towards the north.

The animal possesses no peculiarities. It is almost colourless, with short tentacles and distinct black eyes at the base, a moderate oval foot with the sole undivided, and short proboscis. It differs from *Cyclophorus* and its allies only in the shorter and less subulate tentacles and rounder foot.

19. HYBOCYSTIS, Bens.

The animal of *H. grvida*, Bens., is similar to that of *Pupina*;

the general form of the shell resembles *Raphaulus*. There is no trace of a sutural tube, or of any modification of it. The operculum is very peculiar, and unlike that of any other genus amongst the Cyclophoridae*.

A second species of this genus, very closely allied to *H. grvida*, was obtained from the Laos Mountains, Cambodia, by M. Mouhot. I am indebted to Mr. Hugh Cuming for specimens both of this species and of the *Alycæi* from the same locality.

20. MEGALOMASTOMA, Guilding.

Three species from India and Burma have been assigned to this genus, viz. :—

M. funiculatum, Bens. Darjiling.

M. pauperculum, Sow. Bhotan.

M. sectilabre, Gould. Tenasserim.

A fourth very closely allied species is found in Borneo.

I have very little doubt that *M. pauperculum* is merely a variety of *M. funiculatum*. The latter species is common at Darjiling, at 6000 to 7000 feet elevation. Above this elevation a variety occurs in which the basal keel is less pronounced, the shell somewhat thicker, and the colour of the epidermis olivaceous; and this I believe to be the form to which the name of *pauperculum* was given. There is a complete passage between the two varieties, the smaller of which formerly abounded on the top of Sinchul, a mountain near Darjiling, between 8000 and 9000 feet high.

M. funiculatum is peculiarly interesting, as showing in a rudimentary form the basal keel which is typical of the Ceylonese genus *Cataulus*.

Dr. Gould has suggested for the Asiatic species of *Megalomastoma* the generic appellation of *Coptocheilus*, stating that, with the exception of *M. Antillarum*, all the West-Indian species differ greatly in form from the East Indian. This is true; but the exception vitiates the distinction. I have very little doubt indeed that Dr. Gould's surmise of the distinctness of the two types will prove to be correct, and that the oriental and occidental species must be separated from each other; but I do not think that they have as yet been satisfactorily shown to have generic distinctions. The animals of the Eastern forms are allied to *Pupina* and *Cyclophorus*, having subulate contractile tentacles of moderate length, with the eyes at the side of their bases, a moderate proboscis, and a rather long undivided foot. The lingual ribbon has not been examined. It is desirable to ascer-

* I have not been able to compare the lingual ribbons of these various forms, although I obtained several of them.

tain whether the animals of the West-Indian species differ in any particular.

21. CATAULUS, Pfr.

The rather numerous known species of this genus are, with two exceptions, confined to the island of Ceylon, these exceptions being one species, of abnormal form, from the Nicobar Islands, and a second, recently discovered in the Anamully Hills of South India, and specimens of which are amongst Mr. Hugh Cuming's rich collection.

I have already mentioned that the nearest approach to this genus is in a Himalayan species of *Megalomastoma**. The species of these two genera agree so well amongst themselves in form, and differ so much from the other *Pupininae*, that they may fairly claim to be formed into a distinct subfamily, differing from the typical *Pupininae* not only in shape, but in their thick epidermis and sculpture, and, in general, their solidity and opa-

* This alliance of the Ceylonese hill-fauna to that of the Himalayas, with its marked Malayan affinities (the connexion being, in most cases, through the hill-fauna of Southern India) is a much more rational explanation of any similarity which may exist between the animals inhabiting Ceylon and Sumatra than Sir Emerson Tennent's very startling suggestion of a former continuity of land between the two islands (Nat. Hist. Ceylon, pp. 60-67), an hypothesis in favour of which there is no geological evidence whatever. It would require too much space to enter into the matter at full length; and Dr. Falconer has amply refuted Sir Emerson Tennent's strongest argument (Nat. Hist. Review, vol. iii. p. 95). It is notorious that the fauna of the plains of Ceylon, by far the greater portion of the island, is identical with that of the plains of Southern India; the sole distinctions are founded on the species of animals inhabiting the isolated mass of hills in Southern Ceylon. But, the elephant-fallacy having been disposed of by Dr. Falconer, a comparison of lists of the known animals inhabiting Ceylon, Sumatra, and the hills of Southern India respectively would soon settle the question.

The fact is that the similarity of the Ceylon and South-Indian fauna is very marked, but that while Ceylon has enjoyed the advantage of a considerable European population scattered widely over its surface, and the presence of an unusual number of naturalists, there are few accessible parts of the world the natural history of which has been more neglected than the hills of Southern India. With the exception of the Nilgiris, scarcely anything is known concerning them. The Anamullies, exceeding the Nilgiris in height, and nearer to Ceylon, have only at rare intervals been visited, and then chiefly by sportsmen; and of the ranges further south the very names are unknown to naturalists. So ignorant have we been of their Molluscan fauna that the largest land-shell in India, *Helix basileus*, Bens., was undiscovered until six years ago, although it abounds at the foot of the Anamullies. Later still, species of *Tanalia* and *Cataulus*, genera hitherto supposed to be peculiar to Ceylon, have been obtained from the same neighbourhood. *Helix basileus* also belongs to a Ceylonese (and perhaps Malay?) type not previously met with in the Indian peninsula; and there can be no rational doubt that, with the further exploration of the South-Indian hills, the claims of those of Ceylon to be considered a distinct zoological province will vanish completely.

city,—all which contrast strongly with the polished unbroken surface and delicate translucent shells of the *Pupina* group. But, as above mentioned, the genus *Raphaulus* shows, in some of these characters, a tendency to a passage.

22. POMATIAS, Studer.

Two species of Indian shells have been described by Mr. Benson, and attributed to this South-European genus, viz.:—

P. Himalayæ, Bens., from near Darjiling.

P. (Bulimus) pleurophorus, Bens. Khasi Hills.

A third species has recently been obtained by Mr. Theobald from Arakan.

These species agree well in general form and in sculpture with the European members of the genus. Some slight differences, however, in the characters of the peristome and of the operculum may be sufficient to entitle the Indian forms to sectional or even subgeneric distinction.

23. HYDROCENA, Parreyss.

Several minute forms from the Khasi Hills and Burma have been described by Mr. Benson as belonging to this genus. They, however, prove, on examination of the animal and operculum, to differ so widely from the type, that I propose to distinguish them as a new genus, probably belonging to a distinct family.

GEORISSA, nov. gen.

Testa imperforata v. vix perforata, minima, conica, succinea v. rubella, plerumque spiralter sulcata v. striata.

Opere. semiovale, sine ullo vestigio structuræ spiralis, excentrice striatum, testaceum, transparens.

Animal parvum, lobis hemisphæricis in loco tentaculorum munitum. Oculi normales. Pes brevis, rotundatus.

Type, *G. pyxis*, Bens., sp.

The species of which I have examined the animal is the little *G. pyxis*, Bens., from the neighbourhood of Thayet Myo in Pegu, where it abounds, adhering to limestone rocks. It is found, in similar localities, throughout the region of Pegu west of the Irrawaddy. All the other species, so far as I am aware, also occur in the neighbourhood of limestone; *G. frustillum*, Bens., from the vicinity of Ava, certainly does so. The operculum of the last-mentioned species I have also examined, and found it to be precisely similar to that of *G. pyxis*.

The other species which may be referred to this genus are

*G. illex**, Bens. Tenasserim.

* The operculum of *Hydrocena illex* is described as paucispiral. In these very minute shells it is so difficult to examine the opercula, that very

G. Rawesiana, Bens. Molmain.

G. sarrita, Bens. Khasi Hills.

And perhaps

Hydrocena milium, Bens. Khasi Hills.

H. tersa, Bens. Khasi Hills.

As regards the position to be assigned to this genus amongst the operculated land-shells, it will be observed that it differs widely, in the important character of the form of the tentacles, from all other genera belonging to the Cyclostomacea; while its operculum agrees with that of the *Helicinidae* in the absence of spiral structure and of form. It must evidently be separated widely from *Hydrocena* and *Omphalotropis*, which have the normal tentacles of the *Cyclophoridae* and a paucispiral operculum. For the present it may perhaps be best classed as a subfamily of the *Helicinidae* equivalent perhaps to *Stoastoma* and its allies.

24. ОТОПОМА, Gray.

A solitary species of this genus is found in Western India, in Kattiawar, in a climate which shows a slight approximation to that of Persia and North-east Africa, being on the verge of the area of the periodical rains of India and South-east Asia. This species has been assigned to *O. clausum*, Sow., of Socotra and Arabia; but a comparison of specimens from Kattiawar with the original types of that shell in Mr. Cuming's collection has convinced me that they are distinct. The Indian form is much smoother, with a less excavated umbilical region, and a higher spire; and I propose to distinguish it as *O. Hinduorum*.

I had long supposed that this species was the only representative of the *Cyclostomidae* known to occur in India. *O. blennus*, Bens., from Molmain, has been since shown by its describer, Mr. Benson, to have been founded in error; and *O. spurcum*, Grat., is doubtless a species of *Cyclotopsis*. The discovery of the true character of *Cyclotopsis semistriata*, Sow., proves that representatives of the family are found throughout India, but only in the peninsula, and none are known to occur in Burma.

25. HELICINA, Lamarck.

A species of this genus is found as far north as Ramri Island, on the coast of Arakan. It is very closely allied to *H. Andamanica*, Bens., from the Andamans, and more remotely to the Tenasserim *H. Merguensis*, Pfr., and is the most westerly representative of the genus yet met with in Asia.

possibly the excentric striation has been taken for paucispiral structure. I have not been able to examine *H. illex* lately.

The following is a summary of the classification which I believe to be in accordance with the natural affinities of the various forms mentioned, and the reasons for the adoption of which I have given in the preceding pages. Believing that the several characters of the generative organs, of various parts of the mouth, of the tentacles, the universal presence of an operculum, and the form of the mantle, taken together, far outweigh those of the membranous sac which constitutes the breathing-organ, I agree with those naturalists who class the order Cyclostomacea with the Prosobranchiate Gasteropods, and not with the Pulmonifera. I also believe that the characters of the animal serve quite as fully to distinguish *Cyclophorus* and its allies from *Cyclostoma* as those of the operculum do to separate either from *Helicina*; and that if *Helicina* be considered the type of a distinct family, *Cyclostoma* must take an equal rank.

I have preserved the style of classification employed by Dr. Pfeiffer. My own prepossessions would be in favour of reducing the rank of the several divisions, and of ranging the subfamilies, with a few additions, as genera, and the genera as subgenera; but the question is rather one of convenience than of importance.

List of the Genera of Operculated Land-Shells inhabiting India and Burma.

I. CYCLOSTOMIDÆ.

Cyclotopsis.

Otopoma.

II. CYCLOPHORIDÆ.

1. CYCLOPHORINÆ.

Cyclophorus.

Leptopoma.

Lagocheilus.

Craspedotropis.

Aulopoma.

Pterocyclos.

Rhiostoma.

Spiraculum.

Opisthoporus.

Cyclotus.

Cyathopoma.

Jerdonia.

2. ALCÆINÆ.

Alycæus.

Dioryz.

3. PUPININÆ.

Raphaulus.

Streptaulus.

Pupina.

Hybocystis.

4. MEGALOMASTOMINÆ.

Megalomastoma (*Coptocheilus, Gould*).

Cataulus.

5. POMATIASINÆ.

Pomatias.

6. DIPLOMMATININÆ.

Diplommatina.

Opisthostoma.

Clostophis.

III. HELICINIDÆ.

1. HELICININÆ.

Helicina.

2. GEORISSINÆ.

Georissa.

IV. ACICULIDÆ.

Truncatella.

XLIII.—*Notes on Irish Vespidae*. By RICHARD LESTOCK
EDGEWORTH, of Trinity College, Dublin*.

THE subject which I have the honour of bringing before the notice of the Dublin Natural History Society this evening is one of peculiar interest—both because we possess no memoir on the *Irish Vespidae*, and because the internal œconomy of the *Vespidae*, as of all the higher Hymenoptera, cannot but command our unqualified admiration. Of the seven species of British wasps described by Mr. Smith we possess only five:—three ground-wasps—the *Vespa vulgaris*, *V. Germanica*, *V. rufa*; and two tree-wasps—the *V. Britannica* and *V. holsatica* or *sylvestris*. The *Vespa borealis* (a species originally discovered by Mr. Smith) and the *V. Crabro*, as far as I am aware, have not been yet noticed in Ireland.

Before I proceed to the consideration of the details of each species, it is necessary to allude to the estimate of wasps in a populous community, originally made by Réaumur, and since repeated by many naturalists. Réaumur assumed that there were 10,000 cells, and that each cell produced during the season three wasps, thus producing 30,000 wasps. That Réaumur's calculation is erroneous is proved by the fact that 30,000 wasps could not be contained in any average nest. For, assuming, according to Mr. Smith, that each wasp is in length seven lines, and in depth and breadth respectively two lines, the space which each wasp must occupy will be 0.0162 of a cubic inch; therefore 30,000 wasps will almost occupy the entire contents of a sphere whose diameter is 10 inches. Now a nest of such dimensions as this is seldom to be met with in these countries. I have therefore shown that the 30,000 wasps which Réaumur postulates would occupy the solid contents of the largest known nest. But two-thirds of each nest is occupied with cells; therefore in a nest of 10 inches in diameter there could not be more than 10,000 wasps in the closest possible juxtaposition. Now it is reasonable to suppose that each wasp requires at least three times its own space; therefore even a nest of 10 inches in diameter could not contain more than 3000 wasps.

Again, I shall show that those phenomena are not presented which we should expect from the presence of 30,000 wasps. I find by observation that each wasp occupies about twenty minutes in each journey, and remains about twenty minutes in the nest after he has come in, and therefore each wasp passes the entrance of the nest three times an hour; therefore the number of wasps in a nest is a third of the sum of exits and en-

* Communicated by E. Perceval Wright, M.D., F.L.S., Professor of Zoology, University of Dublin.

trances observed in an hour ; or, conversely, the sum of exits and entrances is three times the number of wasps. Accordingly, in a nest of 30,000, the number of exits and entrances would be 90,000 per hour, or 1500 per minute ; and such a nest, I believe, has not yet been observed. I should also add that I have seldom seen a nest which contained 2000 wasps. Mr. Smith has seen one with 2590 ; but it is very possible that climate may affect the size of wasps' nests very considerably. The nests of wasps vary in size very much, according to the favourableness of the weather. In dry seasons they are generally larger. The mildness of April and May, not so much as the number of queens seen in the spring, or the quantity of nests the preceding year, seems to affect the number of nests for the present year. Wasps are very delicate animals, and peculiarly subject to the influence of the weather ; but the severity and wet of winter itself do not appear to affect their number the following summer. It is impossible, at least from such circumstances, to predict the number or the paucity of wasps. Such, at least, is my experience, confirmed by carefully comparing the various notices in the 'Zoologist,' which form valuable statistics on this point.

The *Vespa Germanica* seems to be almost a variety of the *V. vulgaris* ; at any rate, the habits of the two are so similar that one description will answer for both. The *Vespa vulgaris* is the common wasp of Ireland ; but in the county Down Mr. Haliday assures me that *V. rufa* is more common. I give no description of this or any other wasp, as Mr. Smith has already completely exhausted the subject ; but it is worth while remarking that the colour and size of this insect seem to depend very much upon the locality in which its nest is situated. I have observed that nests which face the sun generally produce small, bright yellow, very active wasps, whereas the wasps from nests in dark and shady places appear larger, darker, and lazier. The same phenomenon is to be seen among ants—some being lighter and some darker than others, without any other very apparent cause than that suggested by the situation of their nest. It has also been remarked that each individual wasp as it grows older alters considerably in size and colour.

Locality selected for Building.—The situation in which each wasp builds is generally very characteristic of the species, and therefore it is a matter of some importance to endeavour to ascertain the usual locality selected by each different wasp. The nests of *V. vulgaris* are generally formed in dry banks, in the roots of decayed trees, and occasionally in the thatch of cottages or other similar places, but may occur almost anywhere. Mr. Smith says he has seen one in a pump. In the 'Transactions of the Ashmolean Society' (xx. 3), a nest was found in a loaf of

sugar, the shell being partly composed of the surrounding thin paper. I have seen nests in a turf-stack under a window-sill, and in the bottom of a barrel of brown sugar. All the larger nests are to be found in dry sunny spots, but the wasps always seem to like water near them; they also generally build near houses, or at least in cultivated places; and I have seldom found a nest in any exposed situation. It is also a most singular and remarkable fact, which I do not remember having seen noticed, that the *Vespa vulgaris* invariably builds beside the nest of a wild bee, either the *Bombus terrestris* or *agrestis*. In about 90 per cent. of nests I find this to be the case, and the only exceptions to this rule seem to be those nests situated in such anomalous positions as pumps and sugar-loaves. It is often, however, very difficult to find the nest of the wild bee, which frequently consists of only a dozen individuals. On examining the combs of these wild bees, there does not seem to me less honey than there ought to be, though the wasps may be often seen going in and out familiarly.

Wasps, if possible, choose a sloping place in which to build, so that the earth they have been mining may easily roll out of the hole, so much so that at the entrance of their nest a quantity of loose earth is generally to be seen, as if a mouse had been burrowing. Sometimes *V. vulgaris* builds under the thick tapestry of moss that drapes our old banks; but, as a rule, it burrows deeper in the earth than any other species of wasp. Réaumur states that the holes of wasps' nests are generally curved; this, however, seems to me to be the exception, and the largest nests generally have short straight holes. It is, moreover, reasonable that this should be so, as the wasps have less distance to carry out the earth they excavate.

Habits.—To observe the habits and domestic manners of wasps, I found it necessary that the nests should be conveniently near the house. Any nest may be removed in the following manner, which I have always employed and found easy and efficacious:—Having found a nest about the middle of July, stop up the mouth of the hole with wet mud, so that the wasps cannot go in or out. As each wasp returns to the mouth of the hole, knock him down with a leafy branch and then quickly seize him and put him into a glass tumbler, with a piece of board over it for a lid. When all the returning wasps are thus secured, with a small stick bore a hole in the soft mud large enough to emit a wasp, and, as each of the wasps inside issues through this narrow passage, catch and put him into the tumbler. When all the inhabitants are thus captured, remove the earth from the cells and gently lift them into a wash-hand basin; then carry them home, and place them wherever you choose, in a hole six

inches deep and as much broad, with some dry moss under them. Let a piece of stick be fixed over the cells, to which the wasps may attach their nest. Place a piece of board over the cells, and bore a slanting hole in the ground for the wasps to go in and out; and, last of all, empty the tumbler of wasps into the cells. It seems to be immaterial whether the queen be present or not. Some sugar should be placed near, that they may feed themselves easily during the first twenty-four hours. Next morning they invariably commence to repair the injuries which the nest has sustained. Their first care is to fasten their combs by a strong pillar to the transverse stick, which, I mentioned before, should be placed contiguous to the cells. Without something to which they may attach their nest, they will not build; because if it cannot be suspended, it must inevitably be destroyed by the damp which exudes from the surrounding ground. Few animals are so cleanly in their internal oeconomy as wasps, and their first care after transplantation is to clean their nest from any dirt, &c., which may have fallen into it. This duty is in a measure consigned to the males. These males may constantly be seen flying out of the nest, carrying away dead grubs; and often when these are too large to be carried, I have seen the insect drag his load along the grass after him.

It has often been stated that wasps keep a sentinel. I am inclined to think that *V. vulgaris* does not. *V. vulgaris* is very particular, at least in a flourishing nest, that the entrance should be quite clear of weeds, straws, and grass, that the activity of commerce may not be interrupted; and there is often a worker employed in cutting down these blades of grass, who might possibly be mistaken for a sentinel. At one time I had nine nests, which I had removed to within a few yards of the house for convenience of observation, and in none of these could I say that there was a sentinel continually on duty. Each wasp takes only ten minutes, or at most a quarter of an hour, in collecting wood or food. This is easily proved by stopping the entrance of the hole, and by killing all the wasps which return, and in about twenty minutes all will have returned except a few stragglers. Each wasp, on an average, appears to perform two journeys in an hour.

There is a popular story originated by Réaumur, and sanctioned by Messrs. Kirby and Spence, and others, that at the first cold of winter wasps lose all the love for their young for which they were once so celebrated, and that, dragging their unoffending victims from their cells, they scatter their immolated bodies round the entrance of their nest. This statement appears to me to be entirely wrong. Possibly the grubs, in some rare cases, may have been killed by an early frost, and from the number of

the dead it might have been conjectured that they were intentionally slain. But it should be recollected that all the wasps are hatched before the cold weather commences, and about the end of October no grubs will be found in the nest. I have carefully watched many times to observe this tragical *dénouement*, but have hitherto been always quite unsuccessful.

The love which wasps display both for their young and for the place of their birth is very remarkable. I have seen them linger for upwards of twenty days around some fragment of their cells when the nest itself had been carried away. Wasps very soon become familiarized with any animal or with man. I was only once stung, by all my wasps; and then it was because I went in the dark: and they were not in the least disturbed by my presence, or by my taking the glass cover off their nest. I remember, also, once having seen a field-mouse and a nest of wasps share a common hole, and the mouse used to go in and out with perfect impunity. Moreover the presence of other wasps does not disturb their equanimity. On one occasion I planted four colonies of wasps together, each in a separate compartment, but with four minor holes opening into one large one, like four doors opening into a lobby. They all flourished magnificently; the wasps of each nest never mistook their own hole; and the most perfect equanimity and goodwill prevailed. Again, I once bisected two nests and put the two halves of the dissimilar nests together, and both halves were soon surrounded with a common shell and amalgamated into one nest.

Mode of constructing the Nest.—The nest is originally constructed by one wasp, the queen, who, about the middle of April, having selected a suitable spot, commences her labour thus:—From a fibre or stone she builds down a short pillar, to the end of which are attached two or three ill-shaped cells; and this is surrounded by a single envelope of paper. I once had the good fortune to see a nest in this state. This nest is constantly enlarged by adding new layers to the outside, and by cutting away the inner layers. All ground-wasps attach their nest to a fibre or some solid thing; and in this respect their nest resembles that of a tree-wasp, in being suspended from a single point, and not being touched by the surrounding earth. Moreover the concave surrounding walls of earth are always lined with a parietal layer of paper independent of the covering of the nest, so that the nest can be taken out quite perfect, leaving this behind. The material of which the nest is built varies, and is, in point of fact, very characteristic of each species of wasp. *V. vulgaris* generally uses very rotten wood, and, as far as my observation goes, practically and microscopically, generally coniferous. I have frequently observed the workers cutting wood or palings,

and found they always selected the bark of larch or fir. The workers collect in about twelve minutes little bundles of these ligneous fibres, which seem frequently to be mingled with structures of a fungoid nature, and then, returning to the nest in about three minutes, roll out the little ball with their hind legs, and, moistening it with a viscid secretion, spread it into paper. Each wasp seems to have no definite place for working, but commences where his predecessor ceased. When making paper, they are often so occupied that they seem scarcely disturbed by being touched. In some nests, from which I had removed the outer covering, I found that a whole shell for a nest six inches in diameter was built in two days. The nest of *V. vulgaris* in its natural state is extremely beautiful. It is not composed of envelopes of paper, but of small pieces of brittle substance, placed over each other, as Réaumur says, like inverted cockle-shells. This is obviously a provision against damp, to which, from the deep-seated situation of these nests, they are peculiarly exposed, and is not to be found in the covering of *V. rufa*, which builds superficially in a drier situation. When burrowing, if stones too large to be rolled or carried out of the nest are met with, they are ingeniously excavated under. Having dropped large stones into several nests, I invariably found this to be the case.

Food.—The food of *V. vulgaris* appears to be very various; indeed this insect seems to be able to eat almost anything. In the early months of the year, whilst they are still rapacious, their diet seems to be nearly exclusively animal; but in the later months a vegetable fare seems more grateful to their effeminated natures. They are said to be very fond of bees. They devour raw meat, fish, sweet things of every sort, flies, butterflies, spiders; and they have been observed even to kill dragon-flies. I have also several times seen them carry off the grubs from an ants' nest which had been disturbed.

Towards the autumn I have observed a most remarkable phenomenon, that early in the morning our groves—especially beech, fir, larch, and sycamore—actually swarm with wasps. They chiefly infest the top of the trees; and the immense numbers in which they are occasionally present is most amazing. What their object is, I do not know; but it may be to collect the defæcations of the various flies which have swarmed there the day before, or it may be to collect the honey-dew, the secretion of certain *aphides*, which is at that time peculiarly abundant. This latter view is probably the correct one, as Mr. Curtis (*Trans. Linn. Soc.*, 1802, p. 82), when experimenting on *aphides*, found that their secretions “were devoured by bees, wasps, and ants as quickly as produced.”

Vespa rufa.—At Edgeworthstown this is a very rare wasp. *V. rufa* differs in every respect—in appearance, in size, in habits, and in disposition—from *V. vulgaris*. What the humble-bee is to the hive-bee, that the *V. rufa* is to the *V. vulgaris*. He is essentially a stupid wasp. I believe that he is innocuous to man, not stinging without great provocation, being seldom found in the house, and not devouring fruit and groceries. But the great difference, as far as I know, between the habits of *V. vulgaris* and *V. rufa* is, that *V. rufa* makes paper like the tree-wasps, and *V. vulgaris* does not. Moreover the nest of the *V. vulgaris* is spherical, whereas that of the *V. rufa* is considerably flattened at the poles. Again, the *V. rufa* differs essentially from *V. vulgaris* in not being a burrowing wasp. Its nest is generally situated quite superficially under the thick moss of dry banks or in some cavity near the surface already excavated. Occasionally *V. rufa* builds out of the ground, and I have once or twice found its nest under a window-sill or in the decayed wood-work round old outhouses.

The interior of the nest is most remarkable; for considerably more than two-thirds of the cells are for queens and males. Now this is a most curious fact. The consequence of this is, that in the autumn the number of queens and males vastly exceeds that of the workers, and that the interior of the nest presents a very formidable but grand and imposing appearance from the number of these huge insects everywhere moving about. It is also worth remarking, that, though the females are so numerous, this wasp does not seem to increase by any means rapidly, as we should naturally have expected.

There is still another most remarkable fact in the history of this wasp yet to be mentioned; and this is, that whereas the nest of *V. vulgaris* is inhabited till late in November, that of *V. rufa* is almost totally abandoned by the end of September by its queens and all its inhabitants.

V. rufa feeds on small *aphides*, on honey, which it sucks like a bee from flowers, and on various vegetable products. I gave sugar to some wasps of this species, and found that it quite enervated them from active work, and they presented all the appearances of intoxication. *V. rufa* is a peculiarly delicate wasp, and, if its nest is at all molested, has not the energy to repair the injuries inflicted. The nest of *V. rufa* is composed of various vegetable tissues. I exhibited at a meeting of the Microscopical Club of Dublin a specimen of the paper of this wasp; but no definite conclusion was formed as to the component structures, although it was suggested that the tissue resembled that of the *Urtica urens*.

Vespa Britannica (Common Tree-Wasp).—The *Vespa Britan-*

nica is very common in Ireland. Its nest is generally to be found on some branch near the ground. It is particularly fond of building under the branches of young fir trees or in hawthorn-hedges. Of the peculiar situations in which this wasp is sometimes to be found I give examples. I have twice seen it build in a Wren's nest. Mr. Shuckard has found it in a Sparrow's nest; and from various communications to the 'Naturalist,' made at different times, it seems that it is not uncommon for it to build inside a beehive, the nest being suspended from the combs. In all these cases the hive-bees were finally overcome, though they continued sedulously collecting honey to the last. The nest of this insect is very beautiful. It is pear-shaped, of a bluish colour, with a few leaves occasionally attached to the outside to screen it from observation. The paper of which the nest is composed is of a very coarse structure.

There is little very peculiar, as far as we as yet know, in the habits of this species. Dr. Ormerod, in an interesting paper in the 'Zoologist,' distinctly proves that these wasps always keep a sentinel on duty. He observed that the oldest and most crippled of the wasps were appointed for this arduous post. Several years ago I suspended a nest of this species to the ceiling in my room, leaving the upper part of the window open, so that the wasps might have free access to the open air. Though there were few wasps at first, yet in a few days they became very numerous; but such is the power which familiarity has in rendering these animals tame, that I was never stung. These wasps used to go to sleep as soon as the sun set, and were up at the first dawn of light. When taking this nest from its original position, I shook most of the wasps out, and two or three days afterwards I found that they had built a new nest for themselves in the same position. This new nest contained no cells, and was simply a round globe, composed of thick walls of paper. Four times I destroyed the posthumous nest, and four times they rebuilt it. Now, though *V. vulgaris* will obstinately cling to the spot where its cells were, yet I have never known it to attempt to restore its nest.

V. sylvestris, or the Campanular Wasp, is, I believe, pretty common in many parts of this country. The appearance of the nest is very distinctive, being of a pale colour and of small size. The folds of paper cover each other very evenly, like flounces. It builds under dense masses of foliage and under the thatch of houses, or, in point of fact, in any well-protected situation. There is very little remarkable about its habits, except that it stings with extreme severity when disturbed.

Such is the imperfect outline of the history of the Irish *Vespidae*. The subject is full of the deepest interest. Our knowledge.

ledge of the habits of these insects is still in its infancy. The few facts we know are perhaps crude and imperfect; and it is much to be desired that many of the members of this society, who are so well qualified for the task, would turn their serious attention to a branch of natural history where so much that is new and interesting remains to be carefully learned and investigated.

XLIV.—*Diagnoses of new Forms* of Mollusks collected at Cape St. Lucas by Mr. J. Xantus.* By PHILIP P. CARPENTER, B.A., Ph.D.

[Continued from p. 315.]

15. *Nacella peltoides*.

N. testa parva, lævi, cornea, subdiaphana, ancyliformi, apice elevato, valde inaequaliter, strigis pallide castaneis radiata; intus nitidissima, subaurantia. Long. .14, lat. .11, alt. .05 poll.

= *Nacella*, sp. ind., Maz. Cat. no. 262, p. 202.

16. *Acmaea* (? var.) *atrata*.

A. testa solida, rugosa, conica, apice paulum antrorsum sito; extus costis crebris rotundatis irregularibus, hic et illic majoribus sculpta, haud apicem versus discordanter corrugatis; interstitiis minimis; intus alba, castaneo et nigro varie maculata; margine latiore, nigro tessellato. Long. 1.3, lat. 1.0, alt. .5 poll.

Variat margine nigro-punctato, punctis plerumque bifidis. Variat quoque costis parvis, creberrimis; margine nigro.

Intermediate between "*P. discors*," Phil., and "*P. floccata*," Reeve.

17. *Acmaea strigatella*.

A. testa A. mesoleuca simili, sed minore, haud viridi; striolis minimis, confertissimis, plerumque erosio tenuissime sculpta; albida,

* As this expression appears to have been misunderstood, I beg to state the reason for its adoption. It is no longer believed on all hands that every object in nature belongs to some genus or species sharply defined. As a working naturalist, I find many intermediate forms which are constant in certain characters, and which (for the sake of reference) it is desirable to name. I do not choose to profess certainty where I do not feel it, and have therefore adopted the formula "*A.* (? *b.* var.) *c*"—thus leaving it to the judgment of others, or to the certainty obtained by further research, to decide whether *c* be a variety of *b* or a distinct species. I have found "detail" (not necessarily "portentous") far more useful than those loose descriptions which may include many widely dissimilar forms, my rule always being so to describe that I may recognize the shell at a future time without access to the original specimen. Though I cannot acknowledge the accuracy of some of the statements in Mr. Reeve's letter (p. 440), I do not wish to encumber the valuable pages of the 'Annals' by a discussion of them.—P. P. C.

strigis olivaceo-fuscis, plerumque radiantibus, interdum confluentibus picta; apice seepius nigro; intus albida, margine satis lato, strigis tessellato. Long. .9, lat. .74, alt. .3 poll.

Variat colore hic et illic aurantiaco tincto: strigis omnino tessellatis.

According to Darwin, this might be regarded as a cross between the northern forms *A. pelta* and *A. patina*, about to change into the Gulf species, *A. mesoleuca*. The dark variety resembles *A. cantharus*, but the very delicate crowded striæ well distinguish it when not abraded.

18. *Glyphis saturnalis*.

G. testa G. inaequali simili, sed minore, latiore, altiore, tenuissime cancellata; striis radiantibus plus minusve propinquis, plus minusve nodulosis; fissura prope trientem longitudinis sita, minima, lineari, medio lobata; intus callositate albida, truncata. Long. .38, lat. .24, alt. .18 poll.

The minute hole resembles the telescopic appearance of Saturn when the rings are reduced to a line.

Subgenus EUCOSMIA*.

Testa solida, nitida, variegata, haud nacrea: apertura et anfractus rotundati: conspicue umbilicata: peritrema vix continuum, haud callosum.

The shells here grouped are like small, round-mouthed, perforated *Phasianella*. The animal and operculum of the Cape St. Lucas species are unknown. The *Phasianella striulata*, Maz. Cat. no. 283 b (= *Turbo phasianella*, C. B. Ad. Pan. Sh. no. 282), and even the *Lunatia tenuilirata*, Maz. Cat. no. 572, are perhaps congeneric.

19. *Eucosmia variegata*.

E. testa parva, lævi, turbinoidea, nitente, marginibus spiræ valde excurvatis; rosaceo et rufo-fusco varie maculata; anfr. nucleosis regularibus, vertice mamillato; normalibus iv., valde tumentibus, rapide augmentibus, suturis impressis; anfr. ultimo antice producto; basi rotundata; umbilico carinato; apertura vix a pariete indentata; peritremate pene continuo, acuto. Long. .1, long. spir. .05, lat. .07 poll., div. 70°.

Variat interdum rugulis incrementi ornata.

20. *Eucosmia* (? *variegata*, var.) *substriata*.

E. testa E. variegatæ simillima, sed anfr. circa basin et supra spiram (nisi in anfr. nucl. lævibus), interdum tota superficie tenuiter et crebre striatis; striis anfr. penult. circ. x.

21. *Eucosmia punctata*.

E. testa E. variegatæ simili, sed multo majore, multo magis elon-

* Th. εὖ, well; κοσμία, adorned.

gata, angustiore, Phasianelloidea; plerumque fusco creberrime punctata; umbilico parvo. Long. .22, long. spir. .11, lat. .15 poll., div. 50°.

22. *Eucosmia cyclostoma*.

E. testa parva, valde obtusa, lata, regulari, valvatoidea; marginibus spiræ vix excurvatis; pallide cinerea, fusco-olivaceo dense punctata seu maculata; anfr. nucleosis pallidis, mamillatis; normalibus iii., valde tumentibus, suturis valde impressis; apertura vix a pariete indentata; umbilico magno, subspirali. Long. .05, long. spir. .025, lat. .05 poll., div. 90°.

Curiously like a small depressed *Valvata obtusa*, but with the texture of *Phasianella*.

Genus HAPLOCOCHLIAS*.

Testa Colloniam simulans, sed haud margaritacea: apertura circularis, varicosa: columella haud callosa.

The animal and operculum are unknown. Its affinities may be with *Ethalia*.

23. *Haplocochlias cyclophoreus*.

H. testa compacta, parva, solidiore; albida, seu pallide aurantiaca; anfr. v., rapide augmentibus, suturis impressis; tota superficie minutissime spiraliter striolata, nitida; apertura rotundata; peritremate continuo, incrassato, extus varicoso; labio distincto; axi t. jun. umbilicata, adultæ lacunata. Long. .19, long. spir. .06, lat. .2 poll., div. 100°.

When laid on its base, this shell resembles *Helicina*; but the mouth is more like *Cyclophorus*. The young shell is semi-transparent, and resembles a *Vitrinella* with thickened lip.

24. *Narica aperta*.

N. testa parva, inflata, tenui, alba; anfr. nucl. ?...; norm. rapide augmentibus, lirulis crebris spiralibus, in spira hic et illic majoribus, a striolis creberrimis radiantibus minutissime decussatis; suturis valde impressis; apertura subcirculari; umbilico maximo, carinato, anfractus intus monstrante. Long. .28, long. spir. .08, lat. .3 poll., div. 110°.

25. *Fossarus parcipictus*.

F. testa parva, solidiore, spira plus minusve elevata; albida, rufo-fusco varie maculata; carinulis spiralibus acutioribus, quarum circ. vi. majores, striolisque crebris cineta; anfr. ultimo tumidiore; labro acuto, haud intus incrassato; umbilico satis magno, ad marginem carinato: operculo normali. Long. .24, long. spir. .06, lat. .2 poll., div. 90°.

The few specimens found are very variable in outline.

* *Th. ἀπλούς*, unadorned; *κοχλίας*, snail.

26. *Fossarus purus*.

F. testa *F. angulato* simili, sed alba, subdiaphana; anfr. nucl. ii., fuscis, ut in *F. tuberoso* cancellatis; norm. ii. et dimidio, altis, valde tumentibus, carinatis; carinis iv., validissimis, acutissimis, quarum ii. in spira monstrantur; carinulis aliis antice et postice plus minusve expressis; tota superficie minute spiraliter striata; carinularum basalium interstitiis subobsolete decussatis; apertura late semilunata; labro a carinis valde indentato; labio recto, angusto; umbilico magno, carinato; operculo fusco, valde paucispirali, minutissime ruguloso, nucleo antico. Long. .08, long. spir. .03, lat. .08 poll., div. 90°.

27. *Litorina pullata*.

L. testa parva, solidiore, luctuosa; spira satis exserta; nigrescente, seu livido-fusco tincta, lineis spiralibus exilissimis pallidioribus ornata; interdum obscure tessellata; anfr. v., subplanatis, suturis parum impressis; sublaevi, striolis spiralibus tenuiter insculpta; columella intus incrassata; pariete haud excavato. Long. .4, long. spir. .18, lat. .29 poll., div. 60°.

= *Litorina*, sp. ind., Maz. Cat. no. 399, p. 350.

28. *Litorina (Philippii, var.) penicillata*.

L. Ph. testa parva, lineis radiantibus, variantibus, delicatulis, rarius ziczacformibus, et cingulis duobus spiralibus, quorum unum in spira monstratur, elegantissime penicillata. Long. .33, long. spir. .14, lat. .2 poll., div. 50°.

Closely resembling the West-Indian *L. ziczac*, var. *lineata*, D'Orb. Intermediate specimens, however, clearly connect it with the common Mazatlan form.

29. *Rissoa albolirata*.

R. testa parva, alba, crystallina, normali; marginibus spirae undatis; anfr. nucl. iii., laevibus, mamillatis; norm. iv., medio subconvexis, postice supra suturas planatis; basi subplanata, effusa, haud umbilicata; lirulis spiralibus crebris, obtusis, quarum circ. x. in spira monstrantur; apertura subovata, peritremate continuo; labro arcuato, vix antice et postice sinuato, calloso; labio valido. Long. .1, long. spir. .08, lat. .04 poll., div. 25°.

30. *Fenella crystallina*.

F. testa alba, subdiaphana, turrita, ruidiore; marginibus spirae rectis, parum divergentibus; anfr. nucl. ?... (decollatis); norm. v., valde rotundatis, suturis impressis; costis radiantibus circ. xvi., valde rotundatis, haud extantibus, interstitiis latis; striis spiralibus regularibus, in anfr. penult. xvi.; apertura rotundata; basi rotundata; peritremate continuo; labro extus varicoso; labio calloso. Long. .14, long. spir. .11, lat. .05 poll., div. 20°.

31. ? *Hydrobia compacta*.

?*H. testa* lævi, curta, compacta, latiore; marginibus spiræ vix excurvatis; anfr. nucl. normalibus, apice mamillato; norm. iv., tumidis, suturis distinctis; spira curtior; basi rotundata; apertura subovata; peritremate continuo; labio definito. Long. .04, long. spir. .02, lat. .03 poll., div. 70°.

This unique shell may be a *Barleeia*.

32. *Hyala rotundata*.

H. testa (quoad genus) magna, tenui, alba, diaphana; anfr. nucl. normalibus, apice mamillato; norm. iv., globosis, rapide augmentibus, suturis valde impressis; basi rotundata; apertura subrotundata, ad suturam subangulata; peritremate continuo; labio a pariete separato, rimulam umbilicalem formante; columella valde arcuata. Long. .18, long. spir. .09, lat. .1 poll., div. 40°.

A unique shell, resembling a marine *Bithinia*.

33. ? *Diala electrina*.

?*D. testa* subdiaphana, rufo-cornea, nitida; marginibus spiræ parum excurvatis; vertice nucleoso, helicoideo; anfr. iii., tumidis, suturis haud impressis, apice magno mamillato; anfr. norm. iii., subplanatis, suturis distinctis; sculptura haud expressa; tota superficie costulis obscuris, latia, spiralibus, quarum vi.-viii. in spira monstrantur, et iii.-v. circa basim rotundatam, interdum obsoletis, cincta; costulis radiantibus circ. xviii., subobsoletis; apertura regulariter ovata, ad suturam angulata, peritremate continuo; basi haud umbilicata; columella regulariter arcuata. Long. .09, long. spir. .07, lat. .03 poll., div. 30°.

34. *Acirsa Menesthoides*.

A. testa nitida, turrata, majore, solidiore, pallide fusca; anfr. nucl. lævibus; norm. vi., subplanatis, suturis distinctis; lineis crebris spiralibus inculpta, quarum circ. viii. in spira monstrantur; testa adolescente lirulis radiantibus obsoletis decussata; apertura subovali; columella solida, imperforata. Long. .42, long. spir. .3, lat. .16 poll., div. 25°.

35. *Cythnia asteriaphila*.

C. testa C. tumentis simillima, sed umbilico minore, haud carinato; tenuissima, diaphana; anfr. iv., tumidis; vert. nucl. normali, haud stylineo, apice mamillato; operculo tenuissimo, elementis concentricis, nucleo submediano sinistrorsum sito. Long. .03, long. spir. .015, lat. .025 poll., div. 60°.

A solitary specimen was found by Dr. Stimpson, imbedded in a star-fish, like *Stylina*; from which genus the vertex and operculum distinguish it.

36. *Bittium nitens*.

B. testa regulari, rufo-fusca, hic et illic pallida, maxime nitente;

anfr. nucl. iii., lævibus, tumidis, apice submamillato, subdeclivi; norm. vi., tumidis, suturis impressis; costis radiantibus circ. xiv., haud contiguas, angustis, interstitiis undatis; costulis rotundatis, spiralibus, in spira iv., quarum postica multo minor, supercurrentibus, ad intersectiones subnodosis; costulis circa basim subrotundatam iv., haud decussatis; apertura subquadrata; columella haud truncata, obtuse angulata; labro acuto, a costulis indentato; labio inconspicuo. Long. .21, long. spir. .16, lat. .06 poll., div. 20^d.

[To be continued.]

XLV.—*Histological Researches on the Formation, Development, and Structure of the Vegetable Cell.* By Prof. H. KARSTEN.

[Continued from p. 435.]

§ VII.

The Development of Pollen.—Historical notes.—Origin of pollen, in *Althæa rosea*, from endogenous free cells with prolongations inwards of the thickened walls of the mother cell.—Development of aculei on the surface of pollen-grains.

THERE is scarcely a vegetable tissue whose development has been more frequently investigated than pollen. Adolphe Brongniart (*Annales des Sciences Naturelles*, 1827; *Génération et Développement de l'Embryon*, 1827) was the first to observe that, in the congeries of cells in the anthers of *Cobæa*, the pollen-cells originated in fours. Mirbel made a more special study of the development of the pollen of *Cucurbita* (*Recherches sur la Marchantia*, 1833). He found that the granular contents of the mother cell of the pollen became divided into four portions by the inward growth of ridges from the sides of the cell towards the centre, and that subsequently the outer surface of each segment became hardened so as to form a smooth skin, within which a second membrane was in process of time produced. The very similar construction of spores and their development occupied the attention of Mohl the same year (*Entwicklung und Bau der Sporen der kryptogam. Gew., Flora*, 1833). The first appearance of the spores of *Riccia* and *Anthoceros* was recognized by Mohl under the form of four small collections of granules, each of which became enveloped by a delicate membrane. These four masses contained in each cell assumed by mutual pressure a three-sided, obtusely pyramidal form, whilst their fourth side, lying in contact with the parent cell-wall, acquired a convex outline.

Subsequently, Nägeli (*Zur Entwicklungsgeschichte des Pollens*, 1842) having extended and tested the application of Schleiden's theory of cell-formation to the development of the pollen-cell, and Unger (*Ueber merismatische Zellenbildung bei*

der Entw. des Pollens, 1844) having published his observations upon the formation of the pollen-cells, Mohl felt himself compelled, as a result of his repeated investigations of cell-formation, to assume, like Mirbel and Unger, that, in the development of spores and pollen-cells, the division of the cell by constriction is combined with free-cell-formation (*Vegetab. Zelle*, 1851, p. 220).

In my investigations on the organic cell I included the development of the pollen-cells of plants of different families; and the results arrived at differed from all others in these material points:—that the pollen-cell, which consists of a complex system of endogenous cells, is developed freely within the pollen mother cell; that the membranes of the numerous cell-nuclei and nuclear corpuscles contained in the pollen mother cells become themselves extended as the coverings of the pollen-cell, a new vesicle, which enlarges to form the nucleus, being formed in them, and in this again the nuclear corpuscle makes its appearance as a microscopic vesicle; so that the origin of the nuclear corpuscles does not precede the formation of the membrane of the nuclear cell, nor is the production of the pollen-cells dependent upon an antecedently formed cell-nucleus. (*De Cella vitali*, 1843, p. 37, tab. 1 a-i.)

However, I was not at that time prepared to encounter the various scruples and objections which these opinions called forth; consequently the brief statement then put forth, and the simple nature of the illustrations given, did not suffice to meet those objections.

Indeed it is a very difficult matter to deduce the law of cell-formation from the history of the development of pollen, inasmuch as these cells, in the course of their development, are more filled than others with opaque material, and consequently their growth cannot be made the subject of direct observation, but the course of development must be gathered from a comparison of many specimens. Hence it is that the observer is in this case more exposed to error than with the simple cellular plants.

Still it seems to me that we must not pass over this much-debated and still imperfectly elucidated subject; and I will rather endeavour to prove, from what seems to me the most difficult object of investigation (which indeed most illusively represents the phenomena of constriction and fold-formation), that even the processes here taking place may be explained in accordance with the general law of free-cell-formation. I refer to those pollen-cells of Dicotyledonous plants whose primary cells (special mother cells of Nägeli), as also the membranes of their mother cells, become much thickened and often laminated

during the earlier development of the secondary and subsequent generations of the true pollen-cells.

Of these I select the *Althæa rosea* as the best-known example: its June buds, in rapid evolution, before the opening of the first flowers, furnished me with my best material. The later flower-buds, which vegetate more languidly, and perhaps scarcely attain their complete development, are not suited for this investigation. The buds, when taken from the plant, must be examined immediately.

The figures given in Plate V. may be appealed to in illustration, and save description. Figure 13 exhibits the eight large thick-walled cells which occupy the median line of each of the two compartments of the young anther of *Althæa rosea*. Each of these large cells was invested with a double membrane, and its cavity was filled with a granular mucilaginous fluid, in which a nucleus containing one nuclear corpuscle could be detected. (The two uppermost cells were emptied in making the preparation.) Around the central nucleus, at a certain stage of development, were four, or more rarely two, spherical clear spaces, of larger or smaller size (13x). Now and then, also, in the interior of these clear spaces, a central vesicle, indicative of their cellular nature, was visible.

When these endogenous cells do not yet shimmer through the turbid granular plasma, they may not unfrequently be recognized during the gradual action of water upon their mother cells, especially when the latter are still enclosed (as in fig. 13) in their common mother cell. This action of the water consists not so much in a solution of the plasma as in an extension of the membranes of the enclosed cells, by which means the contrast between their cavities filled with turbid mucilaginous fluid and the surrounding granular plasma is rendered more striking.

After this cambial cell-mass has been acted upon by the water for some time, and the cavities within the mother cells have thereby acquired increasing clearness of outline, they suddenly vanish, usually all four at the same instant, and rarely one later than the rest and after acquiring still more distinctness. To all appearance, the tension of the cell-membranes by endosmosis attains its maximum, and then the cells collapse and disappear, their contents intermingling with those of the mother cell.

That these clear spaces, which are seen to enlarge by imbibition of water under the eye of the observer, do actually possess membranous walls, and constitute actual cells capable of endosmosis, is the less doubtful, as a cell-nucleus is sometimes observed in them. And that they may be four-cell-nuclei incapable of alteration in the normal course of growth, is disproved

by the different size of these cells in different mother cells, even in the same anther. By the agency of diosmotic fluids, the secondary pollen-cell detaches itself from the primary cell, and contracts into an irregularly shaped or lobed body upon the granularly cellular contents.

It is at a somewhat later stage of development that these large mother cells of the pollen-cells detach themselves singly from their compartment (fig. 9). The central nucleus is then still recognizable; but its nuclear corpuscle is seen no longer, or with difficulty. The nucleus is situated between four delicate-walled cells, the peripheral portions of the membranes of which are closely applied to the mother cell.

The membrane of the mother cell is more thickened, rather unequally and in laminæ; at that part above the septal wall of the two endogenous cells it is rather thicker, and at a later period its thickness becomes still more decidedly pronounced.

By means of solutions of salts, of sugar, &c., it is possible, even at this stage of development, to separate the contents of the daughter cells from the still delicate primary membrane. The contents of each cell separately form a more or less spherical and smooth mass, whilst the four together constitute a lobed body seen within the centre of the mother-cell, which is divided into compartments by very delicate membranes. These four daughter cells behave, when treated with reagents, in an apparently similar or identical manner with those of *Cladophora* already described. Here also the four daughter cells coherent in the centre may be isolated by the partial solution of their primary cell-walls by reagents; and if the mother cells were injured by cutting, they are, although but rarely, pressed out from it, nearly in the form in which Mohl represented this 'Vegetable Cell' (taf. i. fig. 10).

The granular contents of the secondary pollen mother cells external to the daughter cells either vanish entirely, or a mucilaginous-looking material appears in their stead around these cells, in which case the delicate envelopes of the daughter cells look like the inner contour of a thick-walled cell. In consequence of these changes the pollen mother cell acquires a great similarity to the next phase of development, in which, instead of the central nucleus, a gelatinous mass occupies the centre of the cell betwixt the four daughter cells (fig. 11). This breaking-up of the regenerating nucleus of the cell (nuclear cell) is a sign of the termination of the individual development of the mother cell. The contiguous walls interposed between the four endogenous and much-distended cells form between them apparently simple and very delicate laminæ, which appear to subdivide the cavity of the mother cell then filled with opalescent mucous fluid.

It is this state of things which especially caught the attention of former observers, and which they represented as constituting the first indications of the special pollen-cells.

Unger (*Merismatische Zellenbildung bei der Entwicklung des Pollens*, 1844) thus refers to the subject:—"At first some thin delicate striæ make their appearance within the mother cell, which can, by making the cell revolve, be proved to be nothing else than transparent walls which divide the granular mass into several portions. They are so fragile that they dissolve in water."

These statements of Unger are entirely correct, supposing that the word "first" applies to the ready formed septa; but even in this condition the delicate membranes appeared to me in the end to yield to the solvent energy of the water.

And in fact, if we will not call in the aid of analogy in the interpretation of the phenomena, it seems impossible to prove that those free cells enveloped by the plasma within the pollen-mother cell and apparently soluble in water, and which may be recognized of different sizes within the unequally developed pollen mother cells of the same anther, form, by the mutual apposition of their enlarged membranes simultaneously with the assimilation of the plasma, the line-like and exceedingly delicate septa (whose double nature can very rarely be detected), by which, in a subsequent stage of development, the turbid cell-juice of the pollen mother cell is subdivided.

The conditions here prevailing do not allow, as in *Ecdogonium*, of the actual and continuous observation of the growth of the free endogenous cells, the assimilation of the cell-juice enveloping them, and the formation and increase of their contents. Nevertheless I consider that we are perfectly justified in inferring, from a certainly recognized fact, the occurrence of another similar one, although the latter cannot be observed with the same certainty; and I therefore assume that even the delicate septa, which at a certain stage of development divide the pollen mother cells, are the walls of those free cells which may be detected in them in other similar and earlier states.

This opinion coincides with that of Mohl as expressed in his first-quoted essay on the development of spores.

Moreover in spores, just as in pollen mother cells, four free cells are present, by the expansion of which so as to fully occupy the mother cell the septa in all probability originate.

That these septa are not simple, as supposed by Unger (because even in this very young state they cannot be split by the application of diosmotic fluids), but that they consist of two membranes belonging to two approximated special mother cells of the pollen, was maintained even by Nägeli, although he did not

see the gradual growth of these cells, but, on the contrary, supposed, like Mirbel, that the membrane is produced by the solidification of the peripheral layer of the four portions into which the contents of the mother cell are divided.

In anthers of a rather greater age, the thickening of the membranes of the daughter cells forming the septa commences after the secondary membrane of the mother cell has become considerably thickened and acquired seam-like elevations, like those of the cells of collenchyma, between the pollen-cells which are extending themselves peripherally.

This thickening is first seen at the periphery, where they and the mother cells are in contact, and in the next place at the centre, where the cell-nucleus was replaced by the mucoid mass. The boundary-line is at first difficult of detection, owing, without doubt, to the presence of fluid occupying the intercellular spaces. This is probably the reason why Mirbel considered this portion of the thickened primary pollen-cells as the wall of the pollen mother cell itself (fig. 12).

When the thickening has further advanced, so as to occupy the entire extent of the cell-membrane, the boundary-line of the contiguous thickened membranes again becomes visible. The origin and the growth of the secondary and succeeding cells of the pollen-cell cannot be traced with certainty.

The gristly thickened membranes of the pollen mother cell, together with those primary ones of the pollen-cell connected with them (Pl. V. fig. 7), become absorbed in the future course of the formation of the pollen. When exposed for some time to the action of water in the state of greatest thickening, and therefore probably at the commencement of resorption, they are burst asunder by the pollen-cells, which then swell forth at those points where the thickening is least,—that is to say, upon the peripheral vertical lines of the pollen-cells.

The primary cartilaginous thickened cells of the pollen-cells then remain behind, in connexion with the similarly collenchymatose-looking membranes of the mother cell, in the shape of empty envelopes (fig. 10).

The still very thin-walled membrane of the pollen-cells, thrust out in this manner (the secondary cells representing in situation the primary membrane), extrudes from the often comparatively small rent, and, by the continuous imbibition of water, attains eventually double its original diameter. The great elasticity of the young and unthickened cell-membrane is displayed in a remarkable manner during this expansion: it is often squeezed through an aperture scarcely one-fourth its own diameter; but, after having effected its escape, it resumes its dimensions and globular form. In immediate contact with its inner wall there

is a layer of minute vesicles, which are rendered more evident by the action of a dilute solution of chloride of calcium. If a rather more concentrated solution of this salt be employed, the entire layer of vesicles, together with a delicate membrane by which it is enveloped, and which lines the somewhat thicker external cell-wall, is separated from the latter, which then appears nearly smooth and structureless, or marked with small paler points, which appear to be the impressions of the vesicles previously closely applied to it (fig. 18).

In a rather younger state, these vesicles are so small that no cavity is discernible within them. By endosmotic action, these vesicles, along with the cell-membrane surrounding them, become detached from the outer wall (figs. 10 & 11), which is then seen to be completely structureless and homogeneous. In somewhat older conditions, on the contrary, the membrane of the secondary cell, with the layer of vesicles adherent on its inner surface, are no longer separable by any such means from the mother cell, nor are the vesicles themselves expansible by endosmotic action. These latter, indeed, appear in intimate union with the two superimposed cell-membranes, and exhibit themselves on the surface of the mother cell in the form of small warts or tubercles; and these again, in cells still more mature, assume the character of prickles, such as are seen distributed over the surface of the pollen-cells of *Althæa* and of other Malvaceæ (fig. 17). Simultaneously with this outgrowth of prickles, the collenchymatically thickened wall of the mother and primitive mother cells are absorbed. These, therefore, resemble in this respect the thickened membranes of the true collenchyma-cells, like which also they have the function of collecting nutriment for the younger endogenous cells.

At the period when the tubercles first make their appearance on the surface, the membrane of the mother cell (originally the secondary cell) is coloured blue by iodine after contact for some time with chloride of calcium, but not at an earlier or later stage of growth.

The existence of free daughter cells within the pollen mother cells, and the origin of septa by the coming into contact of their enlarging primary cell-membranes, are more readily observed in Monocotyledons than in the Malvaceæ, the mucilaginous juices of which render examination difficult.

The pollen of *Fuchsia* is especially interesting, and the history of its development easily followed out. Moreover the nature of the interposed corpuscles, as I have stated in my essay on the Sexual Life of Plants (p. 25 *et seq.*), can be made out in it, owing to frequent aberrations in structure under manifold forms.

[To be continued.]

XLVI.—On the Menispermaceæ.
By JOHN MIERS, F.R.S., F.L.S. &c.

[Continued from p. 323.]

5. CHASMANTHERA.

The typical species collected by Schimper in Abyssinia was named *Chasmanthera dependens* by Hochstetter, who gave an imperfect description of the genus in the 'Ratisbon Flora' for 1843. This plant has a very peculiar habit, having large orbicular cordate hairy leaves, on long petioles, and a very elongated slender simple raceme. It belongs to the tribe *Heterocliniæ*, as shown by the structure of its fruit: its putamen is oval, compressed, and 3-dentate, as in *Odontocarya*; but its condyle is internal, globular, and hollow, with an external linear foramen, as in *Tinospora*. Its sepals and petals have the usual ternary disposition, and its 6 central stamens are monadelphous for half their length. Some of the specimens have male flowers, the others are in fruit; although the drupes are not sufficiently matured to distinguish the embryo, the structure of the putamen, with its seed, is quite evident. I have added a second species from western tropical Africa.

CHASMANTHERA, Hochs.—Char. reform. *Flores* dioici. *Masc.*

Sepala 6, alternatim 2-serialia, 3 exteriora linearia, acuminata, extus hirsuta, setis longis ciliata, 3 interiora rotundato-oblonga, margine eroso-denticulata, basi cuneata, concava, tenuiter membranacea, 3-nervia, dorso hirsutiuscula. *Petala* 6, biserialia, sepalis paulo breviora, carnosæ, oblonga, obtusa, imo breviter unguiculata, marginibus vix inflexis, intus linea loriformi prominente signata. *Stamina* 6, petalis opposita, erecta, connata; *filamenta* petalis æquilongæ, e basi ultra medium in cylindrum crassum monodelphum coalita, superne libera; *antheræ* basifixæ, subcordatæ, 2-lobæ, lobis oblongis, collateralibus, connectivo angusto adnatis, rima marginali dehiscentibus. *Ovaria* rudimentaria vel nulla.—*Fœm.* ignotæ. *Drupæ* 3, ovatæ, carnosæ, erectæ, sessiles, apice stylo subexcentrico apiculatæ: *putamen* ovatum, compressum, osseum, extus convexum, carina dorsali in apiculum terminata, ventre planum; *condylus* hinc internus, ovato-globosus, cavus, meatu externo longitudinali perforatus: cætera ignota.

Frutices *Africani* scandentes, ramulis longissimis, dependentibus; folia majuscula, late orbiculata, reniformi-cordata, subsimulobata, 7-9-nervia, tenuia, reticulata, utrinque pubescentia, longissime petiolata: racemi axillares, simplices, petiolo longiores; flores breviter pedicellati, bracteati.

1. *Chasmanthera dependens*, Hochst.;—Abyssinia (Schimper); River Quorra (Baxter).
2. *Chasmanthera nervosa*, nob.;—Africa occident.; Bagroo River (Mann, 888).

The details of these species are given in the third vol. of the 'Contributions to Botany.'

6. FIBRAUREA.

This genus, proposed by Loureiro in 1798, was not acknowledged by botanists till I pointed out its validity in 1851: the authors of the 'Flora Indica' have recognized the justice of this claim, but they have not fully comprehended its true nature. I had rightly arranged the genus in the *Heterocliniæ*, but Drs. Hooker and Thomson placed it in the *Pachygoneæ*, under the conviction that a plant collected by them in the Khasya hills, which they named *Fibraurea hamatocarpa*, belonged to the genus; in this conclusion they were undoubtedly mistaken, as their plant forms the type of a new genus (*Hamatocarpus*), near *Pachygone*. There can be no mistake in regard to Loureiro's typical plant, for that exists in the British Museum, but unfortunately it has neither flower nor fruit; these desiderata, however, are found in other plants from Penang, Malacca, and Borneo. Although the fruit in one of these specimens is not quite matured, there is sufficient evidence to show that the genus is near *Tinomisium*: it has an oblong drupe, with the style on its apex; its putamen is quite thin and smooth, flat on the ventral face, where the condylar process is an internal narrow longitudinal carinal projection, running from the base to the apex, to which the seed is attached near its summit. In its imperfect state, the enclosed seed is oval, nearly flat (by compression in drying), the albumen is not fully grown, but the incomplete embryo, with divaricated cotyledons, is sufficiently perceptible to show the nature of the structure. The above-mentioned authors repudiate the notion that the petals are agglutinated to the stamens, and say they have searched in vain for a confirmation of the fact; but how can we otherwise explain the nature of the projecting frill-like appendage, apparently part of a membrane that surrounds and seems to embrace the filaments; it is easy to insinuate a point some way down between that appendage and the anther-cells which it partly conceals. In *Anomospermum* each filament is enclosed within a free fleshy petal that entirely embraces it, leaving only the anther visible; and if we conceive these to be agglutinated together, we shall have precisely such a stamen as we find in *Fibraurea*: it certainly is not an established fact, although it is a fair inference, and we may expect to meet with the proof at some future time.

All the plants I have referred to this genus coincide with Loureiro's specimen in a very peculiar feature: the two principal nerves which spring from the base are connate with the midrib, sometimes for half an inch in length, so that, technically speaking, they are triplinerved: the leaves are rather large, oblong, generally very coriaceous, the nervures are scarcely prominent on either side, the reticulated veins being wholly immersed, and hardly distinguishable, the petiole is rigid, very tumid at its apex, and still more swollen and tortuous at its base. The inflorescence is axillary, and in the male forms a very lax, wide-spreading panicle, as long as, or three times the length of the petiole; but in the female the panicle is compounded only to the second degree, is more than twelve times the length of the petiole, with elongated patent branches, and rather long, distant, 1-flowered pedicels.

FIBRAUREA, Lour.—*Flores* dioici. *Masc. Sepala* 9, interdum 12, in ordine ternario imbricatim disposita, exteriora bractei-formia, 6; interiora multo majora, ovata vel oblonga, medio crassiuscula, margine membranacea et denticulato-erosa. *Petala* nulla (nisi 6 carnosula filamenta amplectentia et iis arcte accreta). *Stamina* 6, inter se libera, centralia, fasciculata; *filamenta* crassa, subcompressa, subincurvata, infra antheram linea prominente transversali cincta, carinaque antica notata (an petala accreta?): *antheræ* oblongæ, coriaceæ, 2-lobæ, lobis paulo divaricatis, connectivo subimmersis, rima marginali utrinque dehiscentibus. *Ovaria* rudimentaria nulla. *Fœm. Petala* aut *stamina sterilia* 6, lineari-oblonga, obtusa, carnosula, ad basin gynæcii columnaris affixa, eo paulo longiora, sepalis 2-3-plo minora, erecta. *Ovaria* 3, summo gynæcii insita, gibboso-ovata, erecta: *stylus* nullus; *stigma* subexcentricum, e punctis globosis minutis sessile. *Drupæ* 3, oblongo-ovatæ, subcompressæ, carnosæ, læves: *putamen* oblongum, compressum, dorso convexiusculum, ventre planius, et hinc sulco profundo longitudinali notatum, 1-loculare, 1-spermum; *condylus* e sulci duplicatura in carinam linearem fere ad centrum loculi protensam internus, et longitudinalis: *semen* loculo conforme: *integumenta* tenuia, linea longitudinali ventrali incrassata et hinc ad condylum adhærentia: *embryo* (e fructu immaturo adhuc vix plane visus) cotyledonibus foliaceis divaricatis, in albumine carnosio inclusus.

Frutices scandentes, in Asia intertropica, præsertim in insulis vigentes; folia ovata aut oblonga, acuminata, coriacea, glaberrima, triplinervia, longe petiolata; panicula axillaris, laxa et latissime expansa, ♀ longissima; drupæ flavæ.

1. *Fibraurea tinctoria*, Lour.;—China.

2. *Fibraurea chloroleuca*, nob.;—Malacca and Borneo.
3. — *laxa*, nob.;—Borneo.
4. — *fasciculata*, nob.;—Penang.

The particulars of these species are given in the 'Contributions to Botany,' vol. iii.

7. TINOMISCIMUM.

When I proposed this genus in 1851, it was placed by me among the genera of doubtful position, because its male flowers alone were known; but I suggested the probability of its belonging to the *Heterocliniæ*, on account of its habit. The authors of the 'Flora Indica' (p. 205) adopted a similar view, and, though retaining it among the "genera dubiæ sedis," remarked that a plant in fruit from Assam, of Griffiths's collection, described by them (in p. 179), probably belonged to the genus. This I had long before ascertained from a specimen in fruit shown to me by the late Dr. Lemann, where the seeds showed clearly that the genus belongs to the *Heterocliniæ*, as I had supposed. The drupe is more than an inch in length, with a nearly apical style; its thin rugose putamen has a broad, shallow, longitudinal groove on the flattened ventral face; and from this (the condyle) the seed is suspended, or rather is attached to it within the cell: from the immaturity of the nucleus, the precise form of the embryo could not be ascertained; but its thin foliaceous cotyledons were evident in the half-grown albumen; and in these respects it nearly accords with the fruit of *Fibraurea*. The species are all climbers; and the inflorescence consists of elongated slender simple racemes, either single or fasciculated, in the axils of the leaves.

TINOMISCIMUM, nob.—*Flores* dioici. *Masc. Sepala* 9–12 in ordine ternario alternatim disposita, quorum 6 interiora, oblonga, extus scabrido-pruinosa, æstivatione imbricata. *Petala* 6, oblonga, sepalis paulo breviora, submembranacea, marginibus involutis. *Stamina* 6, petalis opposita, subæquilonga, et iis (in alabastro) amplexa, demum libera; *filamenta* gradatim incrassata, aut apice dilatata; *antheræ* introrsæ, 2-lobæ, lobis oblongis, immersis, parallele adnatis, aut divergentibus, rima obliqua dehiscentibus. *Ovaria* rudimentaria 3, centralia, punctiformia.—*Fœm.* ignoti. *Drupe* 3 vel abortu pauciores, ovali-oblongæ, compressæ, styli vestigio apiculatæ: *putamen* oblongum, valde compressum, scrobiculato-tuberculatum, coriaceo-testaceum, dorso convexius, et hinc carina subobsoleta notatum, ventre planius, sulco longitudinali late canaliculatum, 1-loculare, 1-spermum; *condylus* internus, obsoletus, aut potius in striam sulcatam longitudinalem reductus; *integu-*
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menta tenuia, ventre linea longitudinali incrassata signata, et hinc in striam insinuata : *embryo* (e fructu immaturo adhuc vix distinguendus) in *albumine* carnosio inclusus.

Frutices scandentes, in *Asia tropica*, præsertim in insulis, vigentes ; folia magna, ovata, acuminata, coriacea, 3-nervia, sæpius glabra, longe petiolata : racemi plurimi vel solitarii, supra-axillares, simplices ; flores breviter pedicellati.

1. *Tinomiscium petiolare*, nob. ;—Penang.

2. — *Javanicum*, nob. ;—Java.

These are fully described in the 'Contributions to Botany,' vol. iii.

8. BURASIA.

This genus, proposed by Du Petit Thouars in 1806 for some Madagascar plants, was included with much hesitation in the *Lardizabalaceæ* by Prof. Decaisne, in his excellent monograph of that family, his doubts being founded on the minute size of its flowers, the absence of sterile ovaria in the male plant, its introrse anthers, its fertile ovaries having only a single ovule, the cotyledons of its embryo being large, foliaceous, and divaricately placed in distinct cells of the albumen, characters quite opposed to *Lardizabalaceæ* ; but the consideration of its distinctly 3-foliolate leaves, and of the seed being invested by a papillose viscous envelope, preponderated in favour of its position in the former family. I believe I was the first to determine its true affinity, in my 'Notes on *Menispermaceæ*,' in 1851, when it was placed in my tribe *Heterocliniæ*. Lately, however, the authors of the new 'Genera Plantarum' have removed it from that tribe without stating their reasons, and with seeming contradiction have placed it in a doubtful position at the tail of the *Pachygoneæ*, acknowledging at the same time the conformity of its embryo with that of the *Heterocliniæ* ! After the publication of my "remarks" above stated, I had an opportunity of examining the typical specimen in the Paris herbarium ; and though it has only male flowers, the parts accord so well with those of the *Heterocliniæ*, that, having regard also to the details of Du Petit Thouars and Decaisne respecting the structure of the fruit and seed, I have no hesitation whatever in retaining the genus in the position I had long ago assigned to it. The careful examination of the specimen of another species in the British Museum has since confirmed this decision. The genus is certainly singular in having 3-foliolate leaves ; but it must be remembered that throughout the family they are most frequently 3-nerved, and that the leaves of *Jateorhiza* and *Calycocarpum* offer a near approach to those of *Burasaia* in being deeply 3-5-lobed : we know that similar grades of division are common in many families.

papillose viscous covering that enwraps the putamen is evidently analogous to the short tomentum imbedded in a pulpy mesocarp, as seen in *Jateorhiza*, *Odontocarya*, and *Hamatocarpus*, and the fleshy envelope in *Anomospermum*. The description given of the form of its embryo is precisely that found only in the *Heterocliniæ*. From the evidence collected from all sources, which appears to me undeniable, the following generic character has been formed.

BURASIA, Thouars.—*Flores* dioici. *Masc.* *Sepala* 6, ovalia, concava, 2-serialia, 3 exteriora minora. *Petala* 6, oblongo-ovata, breviter unguiculata, carnosæ, 2-serialia, exteriora paulo majora, apice eroso-denticulata. *Stamina* 6, petalis opposita; *filamenta* carnosæ, subbrevia, gradatim incrassata, apice geniculato-clavata: *antheræ* oblongæ, introrsæ, 2-lobæ, lobis adnatis, imo paulo divaricatis et subimmersis, horizontalibus, rima laterali utrinque dehiscentibus. *Ovaria* rudimentaria nulla.—*Fœm.* (char. ex cl. Decne.) *sepala* et *petala* ut in masc. *Stamina* abortiva 6. *Ovaria* 3, gibbosa, 1-locularia, *ovulo* unico angulo ventrali appenso. *Stigma* sessile, truncatum. *Drupæ* 3, carnosæ, supra gynæcium auctum insitæ, ovatæ; *putamen* papillis tectum, mesocarpio viscoso indutum, ovatum, plano-convexum, 1-loculare, *condylo* concavo in loculo protenso: *embryo* intra *albumen* copiosum fere rectus, *cotyledonibus* planis, foliaceis, in locellis distinctis divaricatis, *radicula* supera, stigma spectante.

Frutices *Madagascarienses*, *glabri*, cortice *rimoso*; folia *longe petiolata*, *palmatim* 3-foliolata, foliolis *ovatis*, *lanceolatisve*, *integerrimis*, *coriaceis*; racemi *pauci*, *axillares*, *fasciculati*, floribus *parvis*, *breviter pedicellatis*.

1. *Burasia Madagascariensis*, P. Th.;—Madagascar.
2. — *gracilis*, Decne.;—Madagascar.
3. — *congesta*, Decne.;—Madagascar.

Descriptions of these species are given in the 'Contributions to Botany,' vol. iii.

[To be continued.]

XLVII.—Descriptions of new Species of Helix and Pupa from the Colony of the Cape of Good Hope. By W. H. BENSON, Esq.

THE following species were chiefly received from Mr. Edgar Layard, who has been assisted in collecting shells by several correspondents in distant parts of the colony.

1. *Helix Arnotti*, B., n. sp.

H. testa obtecte perforata, subconoideo-depressa, irregulariter oblique

striatula, sublaevigata, superne non nitente, lineis confertissimis vix impressis, sub lente decussata, infra polita, translucente, viridescenti-cornea; spira subconoidea, sutura impressa, anguste marginata, apice obtuso; anfractibus 4, gradatim accrescentibus, convexiusculis, ultimo versus peripheriam obtusam depressiusculo, subtus convexo; apertura obliqua, suborbiculato-lunata; peristomate tenui, recto, acuto; margine columellari oblique descendente, superne breviter calloso-reflexo, perforationem obtegente.

Diam. major $15\frac{1}{2}$, minor 13, axis 9 mill.

Habitat prope Colesberg. Detexit D. Arnott.

2. *Helix Phytostylus*, B., n. sp.

H. testa imperforata, turbinato-subglobosa, tenui, irregulariter oblique striatula, lineis minutissimis confertissimis spiralibus decussata, albida, opaca, strigis obliquis, angustis, luteo-fuscis, translucen-tibus, politis ornata, periomphalo, peristomate aperturaque intus colore eodem tinctis; spira convexa, conoidea, sutura impressa, apice obtuso; anfractibus 5, convexiusculis, ultimo rotundato, subtus convexo, periomphalo anguste excavato; apertura obliqua, rotundato-lunari; peristomate tenui, acuto; margine columellari bitorto, superne intrante, circulariter subexcavato, medio angulato-dentato, setate calloso, aurantiaco.

Diam. major 16, minor 14, axis 12 mill.

Habitat ad Colesberg, et prope Riversdale.

A single specimen from Colesberg was sent for examination by Mr. E. Layard. Subsequently, I received from Riversdale, in the east part of Swellendam, specimens in various stages of growth, collected by a relative, Mrs. J. F. Hudson. The younger shells are more translucent, and the twisted columella has a thinner and less angularly projecting laminar tooth, the base of which, in adult specimens, has a resemblance to the truncation observable in *Achatina*.

Some specimens are marked with irregular, grey or translucent corneous spots. The hydrophanous colouring reminds the observer of the banded white and corneous brown species, *H. Cotyledonis*, B., which I discovered near Simonstown, and which is evidently a near ally of *H. Phytostylus*, from the tendency to a callous twist apparent at the upper part of the similarly entering columella.

3. *Helix Capsula*, B., n. sp.

H. testa imperforata, subconoideo-depressa, tenui, oblique striatula, sub lente minutissime obsolete decussata, translucente, polita, viridescenti-cornea; spira convexiuscula, sutura impressa, submarginata, apice vix elevato, obtuso; anfractibus 4, rapide accrescentibus, convexiusculis, ultimo antice majore, subtus convexo, medio excavato, peripheria rotundata; apertura obliqua, orbiculato-

lunata, intus margaritacea, peristomate acuto; margine columellari arcuato, superne vix incrassato.

Diam. major 13, minor 10, axis 6 mill.

Habitat prope Simon's Bay.

Occurs in a ravine behind the Admiralty House, Simonstown. Mr. Layard reports the animal to be beautifully marked with black, white, and grey in spots and bands.

4. *Helix Hudsoniae*, B., n. sp.

H. testa minutissime obtecte perforata, globoso-depressa, tenuissima, laevigata, striatula, lineis minutissimis confertissimis spiraliibus superne decussata, prope umbilicum polita, cornea, translucente, prope suturam linea angusta rufescente ornata; spira depresso-conoidea, sutura submarginata, apice obtuso; anfractibus 3½, rapide accrescentibus, convexiusculis, ultimo lato, ad peripheriam rotundato, subtus convexo; apertura obliqua, globoso-lunata, marginibus subconniventibus; peristomate tenni, acuto; margine columellari superne breviter reflexo, perforationem obtegente.

Diam. major 12½, minor 10½, axis 7 mill.

Habitat ad Riversdale.

A single full-grown specimen, with the young, was received from Mrs. J. F. Hudson, with *H. Phytostylus*. The shell has a Vitrinoid appearance; but the sculpture, perforation, and suture, as well as the character of a portion of the animal remaining in the shell, prove it to be a *Helix*.

5. *Helix Prionacis*, B., n. sp.

H. testa umbilicata, conoideo-depressa, superne et infra fortiter oblique plicata, plicis remotioribus, albidis, albido-cornea, superne hic illic maculis fuscis ornata; spira conoidea, sutura impressa, apice obtusiusculo; anfractibus 5, convexiusculis, angustis, ultimo compresse carinato, subtus convexo; apertura late lunulata, securiformi; peristomate tenui, acuto; margine columellari expanso, superne dilatato.

Diam. major 6, minor 5, axis 3 mill.

Habitat prope Bredasdorp.

A single specimen was sent by Mr. E. Layard for examination. It has some relation to the following species, *H. Browningii*.

6. *Helix Browningii*, B., n. sp.

H. testa anguste umbilicata, conoideo-depressa, tenui, superne et subtus prope carinam solum plicis albidis confertim oblique plicata, versus umbilicum laevigata, albido-cornea, strigis obliquis rufis superne subtusque oblique ornata; spira conoidea, sutura impressa, apice obtusiusculo; anfractibus 5, convexiusculis, superioribus convexis, ultimo angulato, subcarinato, subtus subcon-

vexo; apertura late securiformi-lunulata; peristomate tenui, acuto; margine columellari expansiusculo.

Diam. major 5, minor 4, axis 3 mill.

Habitat prope Cape Point.

This shell was discovered by Mr. George Wing Browning, magistrate at Simonstown, a zealous collector in natural history. I examined two specimens in the collection of Mr. J. Sydney Hawkins, by whom they were brought from the Cape. The species is smaller than *H. Prionacis*, with the same number of whorls; the plication is closer, less deep, and more regular, and extends only just below the angulate periphery, instead of to the umbilicus, which is wider in *H. Prionacis*. In the latter species the periphery is more compressed, the rufous-brown markings are more disposed to be spotted than strigate, and do not extend to the lower side as in *H. Browningii*.

7. *Helix Omphalion*, B., n. sp.

H. testa umbilicata, subgloboso-depressa, superne confertim oblique plicata, subtus striata, lucida, polita, viridescenti-cornea; spira subconvexa, sutura subprofunda, apice obtuso; anfractibus $3\frac{1}{2}$, convexis, ultimo rotundato; apertura obliqua, rotundato-lunata; peristomate tenui, acuto; margine columellari verticaliter descendente, late reflexo; umbilico angusto, profundo.

Diam. major $4\frac{1}{2}$, minor 4, axis $2\frac{1}{2}$ mill.

Habitat prope Simonstown. Teste J. S. Hawkins.

A more minute, darkly coloured species, and with a narrower umbilicus, than *H. dumeticola*, B., which I took in the same neighbourhood, and more nearly approaching to, but quite distinct from, the large Natal form *H. vernicosa*, Krauss.

An immature specimen of Pfeiffer's fine typical *Helix Schärffæ*, from Bredasbosch, figured in pl. 2. figs. 2 & 3 'Malak. Blätter' for 1861, was received from Mr. E. Layard. It occurred at Oudebosch, near Gnadendal, in the same quarter whence Dr. Pfeiffer's specimens were procured. Mr. Layard also sent a smaller whitish variety from Swellendam, and another variety (white, with chestnut bands) from Bredasdorp, to the north-east of Cape Lagulhas. Mr. Layard reports that the eyes of those varieties are situated at the upper and inner side of a lengthened knob turning down from the summits of the upper tentacula. The foot, when the animal is withdrawn into the shell, looks like a piece of raw meat; and the animal greedily devours other living Mollusca confined with it, but in the bush is attracted in numbers by pieces of water-melons placed as a bait. He also sent a single imperfect specimen of *H. Hartvigiana*, Pfr., received from Oudebosch, and a large variety of *H. bisculpta*, B., 11 mill. in diameter, which occurs at Bredasdorp.

8. *Pupa Fryana*, B., n. sp.

P. testa sinistrorsa, profundissime umbilicata, elongate ovato-conica, oblique plicato-striata, striis confertissimis spiralibus decussata, lilacino-albida, versus apicem rufescente, anfractu ultimo fascia fuscescente infra peripheriam ornato; spira subcylindraco-conica, sutura impressa, apice obtusiusculo; anfractibus 12, angustis, convexis, ultimo antice ascendente, pone aperturam compresso, longitudinaliter lineis 2 impressis signato, superne pone aperturam foveato, crista obtusa utrinque munito, basi circa umbilicum compresse carinata; apertura verticali, soluta, triangulari-obovata; peristomate tenui, undique expanso, reflexiusculo, margine palatali superne profunde sinuato, plicis 2 longe intransitibus inferiore profunda, basali 1 columellaribusque 2 profundis, parietalibus 2 longe intransitibus inferiore profunda, denteque versus angulum columellarem munito.

Long. 8, diam. 4, supra aperturam 3 mill.

Habitat ad Bredasdorp. Detexit J. Fry.

This sinistrorse species is very peculiar, with reference to its deep umbilicus running up to the summit, as in the unique Chinese *P. regalis*, B., its carinate base, and handsome sculpture. In some respects it exhibits a relation to the imperforate *P. Layardi*, especially with reference to the imperfect tube at the top of the aperture, formed by the connivent palatal and parietal plaits. It was discovered at Bredasdorp, at the southern shore of Swellendam, by Mr. John Fry. Mr. Layard reports that the animal is jet-black, very short and thin, the shell being carried on one side, or tilted up if in a line with the animal.

9. *Pupa Pamphorodon*, B., n. sp.

P. testa sinistrorsa, rimato-umbilicata, oblonge conico-ovata, oblique striata, sub lente lineis obsoletis spiralibus (infra magis conspicuis) impressis decussata, castanea; spira cylindrico-conica, apice obtuso, sutura impressa, submarginata; anfractibus 10, convexiusculis, ultimo subtus margine umbilicali juxta aperturam compresso; apertura verticali; peristomate tenui, expanso, aurantiaco; marginibus conniventibus, palatali denticulo 1 superiore plicisque 3 profundis intransitibus tortis, parietalibus 2 inferiore remotiuscula, columellarique 1 profunde intrante intus subduplicata, omnibus albis munitis.

Long. 9, diam. 4 mill.

Habitat prope Simonstown.

Mr. E. Layard reports this pretty species as found in the ravine behind the Admiralty House.

10. *Pupa Dadion*, B., n. sp.

P. testa rimato-umbilicata, ovato-conica, subcylindracea, oblique striatula, micante, translucida, olivaceo-cornea; spira conoideo-cylindracea, sutura impressa, apice obtuso; anfractibus 6, con-

vexis, ultimo circa umbilicum compresso; apertura vix obliqua, angulato-ovata; peristomate reflexiusculo, albido; margine columellari expanso, intus profundo, parietali plica albida intrante superne munito.

Long. $3\frac{1}{2}$, diam. 2 mill.

Habitat ad latus orientale montis "Table Mountain" dicti, necnon prope Simonstown.

This pretty little Bulimoid species was found by Mr. E. Layard under moss on large stones at Paradise, a conspicuous primitive wood high up the face of Table Mountain—a spot which I considered likely to afford shelter to new species, but which I was unable to reach. I requested friends to search for shells there in 1846; but they were not successful. It also occurs in the ravine behind the Admiralty House, near Simons Bay, with *Helix Capsula*.

In the 'Annals' for December 1856, I described a Cape-Point Pupa as *P. Layardi*, from an injured specimen received from Mr. E. Layard. On his return from the Cape, in 1862, Mr. J. Sydney Hawkins favoured me with another imperfect specimen from the same locality, but with the spire intact. Fresh specimens of a smaller variety from Bredasdorp, sent to me by Mr. Layard, with a coloured epidermis, and in a perfect state, I was at first disposed to regard as a distinct species, with reference to the smaller number of whorls and to a remote denticle intervening between the second parietal plait and the columellar one; but in the second Cape-Point specimen this denticle is present, although obsolete in the original example. The colouring of the smaller variety, not observable in the weathered Cape-Point specimens, will doubtless be found in the perfect shell. The following correction will complete the original description:—

Pupa Layardi.—Apice obtusiusculo; anfractibus 9, superioribus convexiusculis, prope apicem convexis; margine parietali denticulo remoto inter plicam parietalem inferiorem et columellarem munito.

Long. 8 mill.

Var. *minor*.—Castaneo-cornea, translucente; apertura aurantiaco-albida; anfractibus 8.

Long. $5\frac{1}{2}$ –7, lat. 2–3 mill.

Habitat ad Bredasdorp.

Cheltenham, April 16, 1864.

Note on some Shells of Southern India.

In the 'Annals' for February 1861, I described, as *Helix Basileus*, a gigantic shell found by Lieut. G. W. Cox in the hills near Trichoor, and, as I subsequently learned, taken at Nellyampaty, in a thick wood situated in an undulating country 3800 feet above the level of the sea, and fifty miles due east of

Trichoor. A larger specimen, from the more southern part of the Travancore range, was reported in the 'Annals' for December 1862. The original site proves to be a portion of the Anamullay Hills, which Mr. W. T. Blanford describes, in p. 374 of the 'Journal of the Asiatic Society' for 1861, as the highest range in Southern India, lying south-west of Coimbatore and of the Nilgiris, where Mr. King made a collection which he afterwards lost. Mr. Blanford informed me that one of the shells taken was evidently *H. Basileus*. In a short paper by Dr. Pfeiffer, published in the 'Proceedings of the Zoological Society' for 1862, p. 117, a large *Helix*, 68 mill. in diameter (4 mill. less than my original specimen), is described under the name of *H. Titanica*, as taken in the Anamullay forest. It is evidently the same species as *H. Basileus*. Dr. Pfeiffer must have overlooked the description which I forwarded to him in May 1861.

Another *Helix*, 30 mill. in greatest diameter, 25 mill. in the lesser, and axis 17 mill., taken, with smaller varieties, by Lieut. Cox in the same quarter, agrees with *H. leta*, Pfr. (not *H. leta* of Gould), the habitat of which was unknown. From the south part of the Travancore range I have received an imperfect specimen of a *Helix* which is apparently *H. Isabellina*, Pfr., previously known from Ceylon. This is an interesting circumstance in connexion with Dr. Pfeiffer's description, in p. 116 of the 'Proc. Zool. Soc.' for 1862, of a *Cataulus* (*C. recurvatus*) from the Anamullay forest.

In October 1860, I described a small *Cyrena* from Quilon as *C. Quilonica*; and in December 1862, I noted it as a *Batissa*, from a more mature specimen. I have since obtained the shell fully grown from Cochin, and find that it was described in the 'Proc. Zool. Soc.' for 1858, by Mr. Sylvanus Hanley, as *Cyrena* (*Batissa*) *Cochinensis*, which name will be retained on the ground of priority to that of *Quilonica*.—W. H. B.

XLVIII.—Note on the Habits of some Mexican Reptiles.

By F. SUMICHRAST*.

I. Family Varanidæ.

Genus *HELODERMA*, Wagler.

Heloderma horridum, Wagler, Wieg.

'Escorpion' of the Creoles †. 'Tala-chini' of the Zapotec Indians.

THIS singular Saurian, the sole American representative of the

* Translated by W. S. Dallas, F.L.S., from the 'Bibliothèque Universelle,' 1864, Arch. des Sci. Phys. et Nat. p. 45.

† The name of *Escorpion* is generally applied in Mexico to all the Saurians whose bite is considered venomous.

family Varanidae, inhabits exclusively the hot zone which extends from the western slope of the Cordilleras to the shores of the Pacific: it has never been met with, to my knowledge, on the side of the Gulf of Mexico. Its conditions of existence confine it to hot and dry localities, such as the districts of Jamiltepec, Juchitan, and Tehuantepec.

The observation of the habits of the *Heloderma* is the more difficult, as this animal, from the sedentary mode of life imposed upon it by its semi-nocturnal habits, eludes continuous investigation. Moreover the extreme terror which it inspires in the natives has contributed not a little to leave its history in obscurity. The gait of this reptile is exceedingly slow and clumsy, which is explained by the shortness and relative thickness of its limbs, as also by the want of flexibility in the articulations. In very old individuals, or in the females before oviposition, the belly acquires a great lateral development, and drags upon the ground—a deformity which adds still further to the repulsive aspect of this curious creature.

It is usually in holes of greater or less depth, dug at the roots of trees or under a mass of vegetable débris, that the *Heloderma* takes up its abode. Here it remains, during the greater part of the day, rolled up in a state of almost complete immobility. It rarely issues from this state of torpor, except early in the morning, before day, or in the evening, at the times when the terri-coloured insects are creeping upon the pathways in the woods. As might be expected from the constraint and slowness of its movements, the *Heloderma* can only attack an easy prey. Its food consists essentially of apterous insects, earth-worms, Myriapods, and small species of Batrachia, and sometimes even of putrefying animal matters. It is fond of the eggs of Iguanas; and it is not unusual to meet with it roaming about near the holes dug in the sand, in which these eggs have been left to the action of the rays of the sun.

The *Heloderma* is a *terrestrial* animal in the full acceptation of the term, and its organization is in intimate relation with its mode of life. Its round and heavy tail could not in any way serve it as an instrument of natation, and its short, thick toes could not enable it to climb trees. Hence it is not in the immediate vicinity of rivers or in the depths of the thick forests that this reptile must be sought, but rather in dry spots on the margins of the woods, or in old clearings, the soil of which is covered with vegetable débris, with rotten trunks and grassea. Without having any positive evidence upon this point, I am much inclined to think that this Saurian remains for a longer or shorter time in a sort of *æstival* lethargy, analogous to that which has been observed in the Alligators in some districts of America.

I am led to this supposition (in which, moreover, I am supported by what I have heard from the natives) by the fact that, during the dry season, from November to June, this reptile is very rarely met with, and it is only seen pretty frequently during the rainy season.

The body of the *Heloderma* usually exhales a strong and nauseous odour, the intensity of which increases at the period when the two sexes seek each other for the purpose of copulation. When the animal is irritated, there escapes from its throat a whitish glutinous fluid, secreted by very large salivary glands. If it be struck during this angry movement, it finally throws itself upon its back, which has led the Indians to say, as a precept to be followed under such circumstances, *that the scorpion must always be attacked in front, because it stings behind*. This singular manœuvre, which the *Heloderma* repeats whenever it is menaced, is accompanied by deep breathings and by an abundant secretion of the glutinous saliva already mentioned.

The natives consider the bite of the *Heloderma* to be exceedingly dangerous, and dread it as much as that of the most venomous serpents, such as the *Tepozo* (*Bothrops atrox*) or the *Mazacoatl* (*Atropos mexicanus* *). In support of this pretended malignity, I have been told of a great number of cases in which ill effects were produced by the bite of the animal, or by eating its flesh in mistake for that of the Iguana. I wished to make some conclusive experiments on this point; but, unfortunately, all the specimens of the *Heloderma* which I could procure during my stay in the countries inhabited by it were so much injured that it was impossible to do so. Without giving the least credit to the statements of the natives, I am not absolutely disinclined to believe that the viscous saliva which flows from the mouth of the animal in moments of excitement may be endowed with such acidity that, when introduced into the system, it might occasion inconveniences, the gravity of which, no doubt, has been exaggerated.

The thickness of the integuments which protect the body of the *Heloderma*, and the hardness of the scaly tubercles with which they are covered, render it almost insensible to the hardest blows; and its instant death is caused only by deep wounds produced by a cutting instrument or a gun-shot. The muscular

* The *Tepozo*, or *Tepocho*, is tolerably common in most of the subalpine regions of Mexico; the species is subject to a great number of variations. The name *Mazacoatl* signifies *Stag-snake* (from *Mazatl*, stag, and *Coatl*, serpent): it has been given to this species on account of the scales turned up in the form of small horns, which fringe the upper margin of the eyelids. This Ophidian, which is less common than the preceding one, inhabits the warm and temperate as well as the colder regions.

movement persists for a long time after death in this reptile; and if we may believe the relations of the Indians, it is prolonged for forty-eight hours or more in the head after its separation from the body.

The colour of the spots scattered over the body and limbs of *Heloderma horridum* is subject to variations, due to age or to difference of locality. These spots pass from whitish yellow to reddish brown, through a series of intermediate shades; their arrangement, which is far from constant, cannot furnish precise descriptive characters. Age likewise produces great changes in the size: some individuals attain a length of nearly 5 feet.

II. Family Iguanidæ.

Genus IGUANA, Laur.

Iguana rhinolopha, Wiegman.

'Iguana verde' of the Creoles. 'Guchachi-guëla'* of the Zapotec Indians.

Genus CYCLURA, Harlan.

Cychura acanthura, Wiegman.

'Iguana negra' of the Creoles. 'Guchachi-chévé'* of the Zapotec Indians.

Although the two species of *Iguanidæ* of which the above is the synonymy belong to different genera, I have thought it best to combine the facts which I have collected upon their history in a single article, in order to give prominence to the principal points in their organization and habits which have induced the separation of the genera *Iguana* and *Cychura*.

Representatives of these two genera of reptiles are found over a great part of the territory of the Mexican republic—that is to say, in all that zone which stretches along the shores of the two oceans, and is known under the name of the *Tierras calientes*. The true Iguanas are more diffused than the *Cychura* upon the eastern side—a circumstance which is easily explained by the fact that this part of the country, being furrowed with water-courses and small lakes (*lagunas*) and covered with a luxuriant vegetation, presents biological conditions the most favourable to the animals, which prefer the vicinity of water. The Pacific coast, on the contrary, is dry and sandy—a condition which suits well with the more terrestrial habits of the *Cychura*, and favours their multiplication.

* These native names are literal translations of the Spanish terms *Iguana verde* and *I. negra*. The Zapotec name of the Iguana is *Guchachi*; *guëla* means *green*, and *chévé*, *black*.

The green Iguana (*I. rhinolopha*, Wiegman) resembles in size, form, and colours the *I. tuberculata* of Brazil: like the latter, it has the sides of the neck sprinkled with conical tubercles, a large scale under the tympanum, and a crest upon the back and the neck; but it is distinguished from that species by the presence of three or four raised scales upon the muzzle. The general colour of the body is a darker or lighter green, with broad, irregular transverse bands of a dark colour; the lower parts are yellowish. In very old individuals, the tail acquires a fine blood-red tint.

The maxillary teeth of the Iguanas are finely serrated on their margins: this structure is connected in these reptiles with an exclusively herbivorous, or, properly speaking, phyllophagous diet. In the stomachs of the individuals which I have prepared I have never found anything but leaves or the remains of soft berries, such as those of the *Goula-beri**. The intestinal sac sometimes attains an extraordinary development, in consequence of the quantity of leaves which are packed into it.

The Black Iguana (*Cyclura acanthura*, Wiegman) varies much in the number and intensity of the spots or bands with which the ground-colour is marked. The following description, taken from a fresh specimen, may give an exact idea of the typical coloration of this species.

Male.—The general colour is a clear silvery grey, brighter on the upper and lateral parts of the body, where the spots are more distant, and almost disappearing under the numerous confluent dark spots which cover the limbs. The upper part of the head, the throat, and the lower part of the legs are sprinkled with small irregular blackish spots; the rostral scales are entirely of this colour. From the posterior margin of the tympanic aperture a long and large spot, formed by the agglomeration of numerous small ones, covers the shoulder as far as behind the anterior legs. From this spot to the origin of the tail there are six black transverse bands, formed, on the flanks, of confluent spots; these, after separating each into two branches, unite, on the median line of the back, with those of the opposite side. On the upper part of the chest is a large spot of a fine black colour, which occupies nearly the whole space between the fore legs. As has been said, the limbs are so much occupied above by the black spots as to appear of the latter colour, with a few irregular rings formed of light spots. The contrary is the case

* This shrub, which is very abundant in the western parts of Mexico, produces berries, of a saccharine taste and of a viscous consistency, which are employed in the manufacture of indigo (*anil*), for the purpose of accelerating the fermentation of the plant and the precipitation of the colouring matter.

with their lower surface. The tail, of the ground-colour, is traversed by ten or twelve broad and indistinctly limited blackish-brown rings. The raised and compressed scales which form the dorsal crest are alternately grey and black, in accordance with the arrangement of the lateral bands which terminate at them.

The dimensions of the body are very different according to the age of the individuals. That from which the preceding description was taken was an adult, and gave the following measurements:—Total length 30 inches (m. 0.75); from the anus to the chin 18.8 inches (0.27); from the rostral to the first scales of the dorsal crest 2.8 inches (0.07). I should add that these dimensions are those of a *Cychura* of middle size, and that they very often exceed the numbers above given.

The maxillary teeth of the *Cychura* are three-lobed at their apex, and the lateral margins are destitute of that fine denticulation which is observed in those of the true Iguanas. By means of this peculiarity they are rendered capable of triturating harder substances; and, in fact, berries with hard kernels, and even insects, are found in the stomach of the *Cychura*. I have also been assured that, in the vicinity of inhabited places, these reptiles do not disdain to feed upon human excrements.

The *Iguana* are more inhabitants of the neighbourhood of water than the *Cychura*, as indeed is proved by the simple comparison of the organs of these two genera of Saurians. The tail of the *Cychura*, which is rounded and covered with spines, would embarrass rather than assist them in the act of swimming, for which, on the contrary, that of the *Iguana*, which is long, slender, and flattened laterally, is admirably adapted. From this difference it results that, whilst the *Iguana* invariably dwell near water, the *Cychura* can depart far from it, without the conditions of their existence being thereby altered.

In traversing the low forests which extend as far as the eye can see on the vast plains of Western Mexico, glades are met with from time to time in which the bare and cracked soil indicates that these bottoms have been covered with water in the rainy season. A few stunted trees, the feet of which still bear the traces of the mud which has bathed them, form the sole vegetation of these wild spots. It is here that, during the season of Lent, the Indians seek the *Cychura*, the flesh of which is regarded by them as a royal dish. Arrived at the open glade, they carefully examine all the holes and clefts of the trunks; and it is rarely that their piercing sight fails speedily to discover some of the poor animals, the objects of their avidity, buried in these cavities. The great difficulty, however, consists in getting the animal to issue from its prison, in which it is literally incrustated. When the trunk is not too thick, a few

blows of a *machete* (a kind of sword) suffice to do the business; in the opposite case, the Indian, with the patience characteristic of his race, will endeavour to gain possession of the unwilling animal by drawing it out gradually by the end of its tail. When once seized by the neck, the unfortunate *Cyclura* undergoes an operation which must deprive it of all power of resistance or hope of flight. With the point of a knife, the hunter cuts the skin of its cheeks along the upper jaw, and passes through this aperture the slender and flexible twig of a liana, which he then unites firmly beneath the chin, so as to prevent any movement of the lower jaw. This done, he half pulls off the last joint of the toes on both the fore feet, attaches one to the other by means of the tendon which is thus laid bare, and passes them behind the head. The same operation is repeated with the hind feet, which are also crossed upon the back. Thus garotted, the animal is unable to bite, scratch, or make its escape.

The *Iguana* are also hunted either by the assistance of dogs trained to their pursuit, or by placing at the entrance of the holes into which they retire running loops attached to the flexible branch of a tree, which seize the animal by its neck as it issues from its burrow.

In the western part of the isthmus of Tehuantepec, where I collected most of the facts detailed in these notes, only the eggs of the green *Iguana* are sought as food; the hunters, therefore, never capture the males of this species, to which they give the name of *Garobos*. The flesh of the *Cyclura*, on the contrary, is regarded as an excellent dish, and its eggs are much prized by the native *gourmands*. These eggs are nearly of the same size and form as those of the *I. rhinolopha*; their greatest diameter is about an inch and a quarter, and their smaller diameter four-fifths of an inch. In several females of the *Cyclura* which I dissected between the 15th and 20th of March, I found from thirty-two to thirty-four eggs, completely developed and placed end to end in the double oviduct which descends from the ovary to the cloaca. The ovary contained, besides, a nearly equal number of other eggs in a less advanced state; some of these were of an orange-yellow colour and of a flattened ellipsoidal form, presenting a lenticular inflation at the centre; others were spherical, larger, and transparent, like those of frogs.

During a voyage upon the river Goazacoalcos, I witnessed a singular operation performed upon a female *Iguana*. One of the Indians who had the management of the canoe, having succeeded in capturing this reptile, opened its belly, carefully removed the eggs, and having sewn up the wound, let the animal go, "in the hope," as he said, "of finding it again some day." At the middle of March the green *Iguanas* begin depositing their eggs,

in large holes dug in the sand. A single excavation sometimes contains as many as ten dozen of these eggs, deposited in it by several females. The same thing is observed in the *Cyclura*, with this difference, that the number of eggs thus deposited in a common hatching-place does not exceed six or seven dozen.

When taken young, the Iguana is easily tamed, and becomes perfectly familiar with the person who takes care of it; the adults, on the contrary, never lose in captivity their natural wildness. These animals endure a long abstinence without any sensible diminution in weight; in many places, the natives, taking advantage of this peculiarity, keep the Iguanas as provision for Lent for more than a month, after having sewn up the mouth and attached the feet.

The green Iguana does not seem to dread the vicinity of the alligators (*A. lucius*, Cuvier) which usually abound on the shores which it prefers for its habitation. The black Iguana, on the contrary, appears to have much fear of them. In one of my expeditions on the Rio Chicapa, I took one alive, and attached it to the prow of the canoe; the animal, having succeeded in freeing itself from its bonds, immediately threw itself into the water, in order to gain the shore; but, at the moment of its arrival, perceiving an alligator stretched in the sun on a small sandy beach, it returned towards the boat with signs of the most lively fear. On this same occasion I had most striking ocular proof of the tenacity of life and the muscular power of the Iguanas. Several of those which I shot, although literally riddled with large shot, still retained sufficient strength to run to the river and plunge into it, after having tumbled down from the tops of the trees on which they were stretched in the sun, a height of twenty or thirty feet.

Genus *BASILISCUS*, Latreille.

Basiliscus vittatus, Wiegman.

‘Pasarios’ of the Mexicans. ‘Zumbichi’ of the Zapotecs.

This charming animal, which does not in any way resemble in its habits the fabulous creature to which the ancients gave the name of *Basilisk*, is common on the margins of nearly all the rivers of the warm and temperate regions of Mexico. It is in the spring, in the breeding-season, that its observation is most easy; and it is then also that the male especially attracts attention, on account of the elegance of his form, the vivacity of his colours, and the grace of his movements. As soon as the sun has warmed the air, he quits his nocturnal retreat, and commences the pursuit of his prey. If the dry trunk of a tree rises from the margin of the water, we may be almost certain of

finding upon it, during the hot hours of the day, a Basilisk acting the part of a sentinel. With his body voluptuously extended, as if to absorb as much as possible of the solar heat, he remains in a state of perfect quietness; but if some noise attracts his attention, he raises his head, inflates his throat, and rapidly agitates the membranous crest with which his occiput is crowned. His piercing eye, with its dull-yellow iris spangled with gold, glances inquisitively on every side; if the danger be imminent, his body, previously flaccid and soft, draws together like a spring, and, leaping with the rapidity of lightning, he throws himself into the water. In swimming, he raises the head and breast; his fore feet strike the water as oars, whilst his long tail furrows it like a rudder. From this habit the animal has received its name of *Pasarios* (*passe-ruisseaux*), which is also applied, although erroneously, to a species of an allied genus, *Corythophanes chamaleopsis*.

At the end of April or the beginning of May, the female deposits from twelve to eighteen eggs in a hole at the base of a stump or trunk of a tree, where she leaves them to be hatched by the heat of the sun. These eggs, which in form and colour are identical with those of the Iguanas, measure four-fifths of an inch in their long diameter, and about half an inch in their shorter. The young reptiles which issue from them in the course of a few days are very different from the adults in their colours.

The food of the Basilisk consists essentially of insects, which it captures with much dexterity when they settle upon the low branches overhanging the brooks, near the spot where it is on the watch.

Age and sex induce some modifications in the colour of different individuals. The occipital membrane and the tail, which in the females and young are of an olive-yellow colour, are tinted with a fine blood-red in the old males.

Genus CORYTHOPHANES, Boié.

Corythophanes chamaleopsis, Dum.

Chamaleopsis Hernandezii, Gray.

Chamaleo mexicanus, Hernandez.

If the kind of osseous casque which characterizes this reptile were not of a very different nature from that which adorns the head of the Basilisk, one would be tempted, at the first glance, to refer the *Corythophanes* to the same genus as the latter, so much do they resemble each other in the form of the body. But in the Basilisk the occipital prominence only consists of a membranous hood, supported internally by a greatly developed

sagittal crest, which becomes cartilaginous at its extremity; whilst in *Corythophanes* it is formed entirely by an abnormal expansion of the bones of the cranium. The facies of the species under consideration also presents some features of resemblance to that of the African Chameleon, which led Hernandez to give it the name of *Chamaleo mexicanus*.

The colours of the *Corythophanes* do not present those brilliant green, yellow, or reddish tints which are observable in the coat of the Basilisk, but a mixture of brown, fulvous, black, and white, which, however, is not unpleasing. I have observed that these tints are not indifferent to the action of light: one of these reptiles, which I kept alive for more than a month, presented this peculiarity:—its throat, which was white during the day, acquired a darker tint at night, as did also all the lighter regions of the body. Although very lively by nature, this little animal allowed itself to be taken and caressed. If I passed my hand several times over the flank, it lay down immediately as if magnetized by this touching. If I repeated the same manœuvre upon the belly, it crossed its fore feet in the attitude of prayer, and fell into a state of perfect immobility. It became so tame that it would run towards me to take from my hand the flies and other insects of which it was fond.

The *Corythophanes* is not a shore animal, like the Iguanas and the Basilisks. It lives scarcely anywhere but in the woods among the rocks, and delights especially in the oak-forests, where the sombre coloration of its body, which harmonizes with that of the dry leaves, enables it to make successful ambuscades for the capture of the insects which constitute its prey. It is exceedingly active, and, when it can take to flight, its capture, except by shooting it, becomes very difficult. In running, it raises the front of the body almost vertically, at the same time lashing the ground with its tail, by which its appearance at such times is rendered very singular.

The credulity of the Indians has not failed to ascribe extraordinary qualities to this little creature, which is at once so pretty and so odd. At the same time that they greatly dread the inoffensive pricking of the spines which are observed on the sides of its head, they extol the virtues of its body, when dried and carried as an amulet, against the evil eye (*el aire*) and that multitude of supernatural ills which are born of their sombre and superstitious imaginations.

The *Corythophanes* are nowhere common; but the species which forms the subject of this note inhabits both slopes of the Cordillera at very distant points. Thus I have met with it near the Haciendas of the Mirador and the Potrero (in the department of Vera Cruz), in the grottoes of the Cerro de Santo Do-

mingo (isthmus of Tehuantepec), and in the forests of Gineta (department of Chiapas). All the specimens which I procured in these different localities were absolutely identical.

Genus *PHRYNOSOMA*, Wagler.

Phrynosoma orbiculare, Wiegman.

'Caméléon' of the Mexicans.

This little Saurian, which is equally curious both in its appearance and habits, owes to this circumstance its having been known to the first observers who traversed Mexico, and also its having been shifted, in the different herpetological classifications, from one family to another, until at last it has come to take up its natural position in the neighbourhood of *Tropidolepis*.

The *Phrynosoma*, which is peculiar to the cold and dry regions of the Mexican plateau, inhabits sandy spots exposed to the sun, such as the margins of roads and the arid ridges, where the earthy colour of its body easily conceals it from observation. Ill formed for running, it has none of that lizard-like vivacity which has become proverbial; its gait is slow and awkward. On seeing it making its way painfully over the sand, we at once perceive that the poor devil must have no little trouble in procuring its daily bread. Its thick tongue, fastened to the palate, cannot be darted, like the Chameleon's, at the insects which pass within its reach; its large and dragging belly prevents it from seizing a prey by running in the manner of the slender lizards, or capturing a fly on the wing like the impetuous *Anolides*. In order that it may dine, one of the heavy beetles of the sands, as ill organized as itself for locomotion, must, so to speak, come to tickle the teeth of this melancholy hunter. This forced abstinence of the *Phrynosoma* has obtained for it, among the natives, the reputation of living upon air.

Destitute of means of defence, it allows itself to be taken without even attempting to bite the hand that has seized it. I have several times kept one of these inoffensive animals alive: they usually remained squatting in a corner of my room; and whenever they disappeared, I was certain soon to find them again in my shoes or in the pockets of my clothes.

On several occasions when I have put females of *Phrynosoma orbiculare* into alcohol, I have seen the young immediately issue from the cloaca, to the number of ten or twelve. I have made the same observation with regard to a species of an allied genus, *Tropidolepis formosa*; and I have reason to believe that most of the Mexican species of *Tropidolepis*, or at least those of the colder regions, are likewise ovo-viviparous.

XLIX.—*Observations on Raphides.*

By GEORGE GULLIVER, F.R.S.

[Continued from p. 409.]

Their Chemical Composition.—Since the observations of Raspail and Edwin Quekett, raphides have generally been regarded as composed of phosphate of lime, and many sphæraphides as oxalate of that earth. But, in the 'Trans. Edin. Bot. Soc.' for 1861, Prof. Douglas MacLagan gave an analysis of the raphides of *Richardia*, from which it results that these are composed of the oxalate. Hence further observations seemed so desirable on the subject, that Dr. Davy kindly undertook, at my request, the examination of several specimens which I sent to him; and, with his permission, the following notes of his experiments are here published:—

"Owing to the minute quantity of matter in the raphides or other crystals (minute even in relation to the quantity of ash afforded by the leaf or other vegetable structure), there is difficulty in coming to more than a proximate conclusion as to their composition. It is not improbable that, in some instances, it is composite, consisting, for example, of oxalate of lime and magnesia. Possibly vegetable matter may influence the reagents. In the scales of the onion, I found the precipitate from an acid solution, by ammonia in excess, in the form only of minute well-defined crystalline globules. Raphides may generally contain a little vegetable matter, in consequence of which their forms, though somewhat altered, remain after the matter which is soluble in an acid (such as phosphate of lime), or is in part fixed after combustion (such as the lime of the oxalate), is removed.

"1. Official *Iris Florentina* contains a good deal of lime. Its white ash consists chiefly of lime, and, strongly heated, emits a brilliant white light. The ash contains a small proportion of phosphate of lime, but a much larger of carbonate. From the crystals resisting the action of dilute acetic acid, I infer that they are of oxalate of lime. They are rapidly dissolved by strong nitric acid, and some by acetic acid, without effervescence.

"2. *Mesembryanthemum muricatum* is readily incinerated (the leaves more readily than the stalk); it yields a good deal of white ash, retaining the form of the leaf, but shrunk. Ignited, it shines with a bright yellow light, that of the stalk with a red light. The raphides, I infer, are composed chiefly of oxalate of lime and magnesia, with perhaps a little silica, the magnesia in rather larger proportion than the lime. They are not dissolved in dilute acetic acid. The leaves, under the action of dilute muriatic acid, give up the greater portion of their saline and earthy

matter: incinerated afterwards, the little ash left is chiefly silica.

"3. Leaf of *Colocasia antiquorum*.—Burnt, it leaves a good deal of white ash, which, before the blowpipe, shines with a bright white light. The ash consists principally of lime, with a trace of phosphate of lime. The raphides, I infer, consist of oxalate of lime: they are not dissolved by dilute acetic acid.

"4. Official *Veratrum album*.—The central or pithy part seems to contain but few raphides, but many large starch-granules; the outer, firmer (liber?), contains more raphides, but not numerous; the starch-granules *there* are very small; the black cortex contains very few indeed of the former, and none of the latter. A portion of the whole yields but little ash: the ash shines with a red light when strongly heated. It contains a little phosphate of lime, and lime, and a trace of iron: the iron, I believe, imparts colour to the bark. It contains also a little magnesia. The raphides, I *believe*, consist of oxalate of lime; the numbers being small, and phosphate of lime in minute quantity being present, it is not easy to speak with any certainty of their composition.

"5. *Bulb-scale of Shallot*.—Burnt, it leaves a white ash, retaining the form of the scale, shrunken, in which the crystals may be seen, their form being unaltered. The ash effervesces with acid, and almost entirely dissolves, a trace of silica only remaining. The crystals (4-sided prisms) appear to consist of oxalate of lime and magnesia.

"6. Leaf of *Heliconia aurantiaca*.—It yields, when burnt, a small quantity of fusible ash: the fused ash is a hard glass, resisting the action of muriatic acid. Besides the raphides, there are a few minute prisms in the leaf. The leaf, digested in dilute muriatic acid, affords a solution which is precipitated by ammonia, as if it contained oxalate of lime, and afterwards by phosphate of soda. Perhaps the prisms consist of oxalate of lime, and the raphides of oxalate of lime and magnesia.

"7. Official *Urginea Scilla*.—Burnt, it leaves a good deal of white ash, which emits a bright white light when strongly heated. The ash consists chiefly of lime, with a little magnesia and a trace of phosphate of lime. The raphides, I infer from the slow action of acetic acid on them, and from their solution being precipitated by ammonia, consist principally of oxalate of lime.

"Roots of *Galium Mollugo* and officinal Jamaica and Guatemala *Saræ*.—The raphides appear to consist of phosphate of lime, judging from their ready solubility in dilute acetic acid, and from the composition of the ash, in which, besides phosphate of lime, there is some lime and magnesia."

The results obtained by this eminent physiologist, including his examination of *Epilobium* ('Annals,' May 1861, p. 423),

are important. They show that true raphides may consist either of phosphate of lime, of oxalate of lime, or of oxalate of lime and magnesia, and that a minute portion of vegetable matter probably forms a part of the raphis: besides, they tend to confirm the accuracy of Prof. D. MacLagan's analysis of the raphides of *Richardia*; for this plant belongs to *Aracæ*, and now Dr. Davy, quite independently, finds that the raphides of *Colocasia*, another plant of the same order, are also composed of oxalate of lime. As to the exact relation of the vegetable to the mineral part of the raphis, whether forming the intertexture and frame of its substance, like the animal cartilage of bone, or a mere pellicle, according to Payen and others, or an appearance only, produced by contact of the plant-juice with the saline crystal, further observations would be very interesting.

Nyctaginaceæ.—Raphides in the seed-leaves and spermoderm, and very numerous in the tap-root and leaves, of *Mirabilis*.

Smilacæ.—Fresh sprig and leaf of *Smilax Sarsaparilla*, and leafless twig of *S. aspera*, from Mr. Sowerby: the former abounding in raphides; and the latter with numerous bundles of them in the young leaf-buds and a few in the liber. Thus, as was expected from the quantity of raphides in the officinal root, they abound in other parts of *Smilax**.

Commelinaceæ.—Raphides abundant in the roots and leaves of *Commelina cælestis* and *Tradescantia virginica*, though not to be found in the British species of *Alisma* and *Butomus* belonging to the orders next following *Commelinaceæ*. Thus, though the external appearance of the tubers of *Commelina* and *Butomus* is similar, they may be immediately distinguished; and the viscid juice of the latter, when let out, being coagulable by and immiscible with water, is another remarkable difference.

Aracæ.—Raphides abounding in the green part and pale spots of the leaf of *Dieffenbachia maculata*, and in the leaf of *Colocasia antiquorum*. In these plants the raphis-cells are elongated and pointed at the ends, quite unlike the short neighbouring cells—thus also unlike the raphidian cells of *C. odora*, figured by Prof. Balfour, though projecting, as shown by that eminent botanist, into the central intercellular spaces of the petiole. *Acorus Calamus*: this is not a raphis-bearing plant.

Persistence of the raphis-bearing character.—We have before

* As Dr. Davy finds the raphides of the root to consist of phosphate of lime, and considering the profusion also of starch in the Jamaica and Honduras samples from Apothecaries' Hall, no wonder that a course of such *Sarzæ* should be so efficacious in certain cachexies, while it might be rationally suggested that the same drug would likewise be useful in those sad and intractable diseases of infants which are connected with imperfect nutrition and a deficiency of phosphate of lime in the bones.

given many proofs of the value and constancy of this character ('Annals,' Jan. and March; and Journ. Micr. Soc. Jan. 1864); but as they were chiefly drawn from Kentish plants, it seemed desirable to extend the inquiry to species grown in different localities. Accordingly Mr. W. H. Baxter, taking an intelligent interest in the subject, supplied me with fragments, from an old herbarium, calculated to afford a further test as to the raphidian character of British Galiaceæ. Some of these were marked "probably poisoned," and others "probably not poisoned;" and their names here follow on the excellent authority of that botanist:—CAPRIFOLIACEÆ: *Lonicera Periclymenum*, *L. Caprifolium*, *L. Xylosteum*, *Sambucus niger*, *S. Ebulus*, and *Viburnum Lantana*. GALIACEÆ: *Galium saccharatum*, *G. spurium*, *G. parisiense*, *G. montanum*, *G. sylvestre*, *G. tricornis*, *G. erectum*, *G. saxatile*, *G. uliginosum*, and *Asperula cynanchica*. VALERIANACEÆ: *Valeriana dioica*, *Centranthus ruber*, and *Fedia dentata*. These three orders are here placed as they stand together in the natural classification. After careful examinations, raphides were found in every one of the specimens of Galiaceæ, but could not be detected in any one of the two other orders. And this is the more remarkable, not only from the state of the dried fragments, but from the fact that the raphides of Galiaceæ are regularly smaller and less abundant than in many other plants (Onagraceæ, for example), as was well seen in comparing the small and scanty raphides of *G. saxatile* and *G. uliginosum* with the larger and more numerous raphides of other dried portions of several species of *Epilobium*. But such is the persistency of raphides, that I have regularly found them in dead stems, leaves, or roots of Onagraceæ and Mesembryanthaceæ which had been fully exposed to the destructive effects of the whole winter and spring; so that even these decayed fragments may thus be surely distinguished from others of allied orders.

Edenbridge, May 9, 1864.

[To be continued.]

BIBLIOGRAPHICAL NOTICES.

The Birds of India, &c. By T. C. JERDON, Surgeon-Major, Madras Army, Author of 'Illustrations of Indian Ornithology.' Vol. I. and Vol. II. Part 1. Calcutta: 1862, 1863. (London: Smith and Elder.)

WE have to apologize to Dr. Jerdon for having so long delayed to notice the valuable work he has published. But, in truth, it is not one to be hurriedly reviewed; for such a proceeding on our part would justly lay us open to the charge of insufficiently recognizing

its importance. It is now a considerable time since our expectations were excited by the news that, after our countrymen had for more than a century securely established themselves on "the shores of Ind," and for many years had pervaded the whole region lying between the Himalaya Mountains and Cape Comorin, we were at length to possess a concise manual of one portion of the fauna of Hindostan. The words of promise are being fulfilled, and there remains now but one more part to complete this useful work. The naturalist, however, can never afford to "rest and be thankful." Knowledge to him, of all men, is infinite, and its acquisition is "never ending, still beginning." Though we do most heartily congratulate our author on the successful issue of his laborious undertaking—or, at least, on having got the worst part of it over,—it is because we regard this book as furnishing a sure basis for future operations that we deem it one of such transcendent merit. The student who wished to become acquainted with the particulars of Indian ornithology had aforesaid to hunt up sporadic papers scattered throughout the publications or reports of we know not how many learned bodies either in Europe or Asia, most of these papers difficult of access, and some, we believe, utterly withdrawn from sight, except at the chief seats of government in the Indian peninsula or here in London. Now all this is changed. When the present work is completed, the "collector of Boggleywollah," if he be so inclined, will be able to start off to his up-country station with three not very thick octavos in his bullock-trunks, and the assurance that he has therein a compendium of all that has been already written on the subject. But on this point we must let Dr. Jerdon speak for himself, which he does with remarkable modesty as regards his own labours, and in cordial and most gratifying terms towards those of one who might almost have been considered a rival instead of a fellow-worker in the same field. Here are the opening paragraphs of his Preface:—

"The present work is the first of a series of manuals which the author proposes to bring out, if his health be spared, on the Natural History of the Vertebrated Animals of India. The want of such books has long been greatly felt in this country; and the increasing attention now paid to natural history calls, more imperatively, for the fulfilment of this desideratum.

"The author's uninterrupted residence for above a quarter of a century in India, during which period he has diligently examined the faunæ of the different districts in which he has been a resident or a traveller, has enabled him to give in detail, from personal observation, the geographic distribution and limits of most of the animals of this country; for, with the exception of the North-West Provinces, the Punjab, and Sindh, he has traversed and retraversed the length and breadth of the continent of India, and has also visited Burmah.

"This experience, and an earnest wish to be of use to naturalists and travellers in India, are the author's chief claims for attempting such an ambitious task; and, had others better qualified come forward, he would have relinquished, however unwillingly, what to him has

been a labour of love. He has, however, had the inestimable advantage of constant correspondence, and, in latter years, of personal intercourse, with Mr. Blyth, of the Asiatic Society's Museum, than whom no one would have been better qualified to write such a work, had his health been good and his time his own. But the constant drudgery of his unassisted labours, and above twenty-one years' residence in Calcutta, have so far injured his health as to preclude the present hope of his publishing a separate work. His voluminous writings, however—reports, notices, monographs, &c.—scattered through twenty volumes of the 'Journal of the Asiatic Society' and in various English scientific periodicals, are permanent proofs of his great talents and industry; and were it not for those writings and the fine collection he has been the chief means of making in Calcutta, the present work would be much more imperfect than it now is."

Of the manner in which Dr. Jerdon has performed his task we must speak in terms of high praise. The scheme of the book is exactly what we think it ought to be—"A Manual of Ornithology specially adapted for India," as it is announced on the title-page, which, as being somewhat redundant, we have taken the liberty to curtail above. To this end the Surgeon-Major prefixes an "Introduction," containing nearly fifty pages of well-digested generalizations, or, as we might almost term them, a summary of the first principles of ornithology. These serve to show, if, indeed, it were necessary, that our author has turned to good account the specific knowledge of which the body of the book proves him to be possessed—knowledge of a kind which so many naturalists, unfortunately, seem to be incapable of applying to higher purposes. But the utility of the "Introduction" is not merely confined to the demonstration of this fact. It is unquestionable, we think, that a book like the present, though long demanded by advanced naturalists throughout the world, has been most needed by a multitude of persons in our mighty pro-consulate—persons who know little of ornithology, though they love it much, amateurs who with the aid thus opportunely afforded them will ripen into ornithologists. Welcome, then, as the rains in their season, will be the 'Birds of India' to men with such tastes, thirsting for information on the subject, for lack of which many of them must have seen their aspirations wither like vegetation in a time of drought.

Our space will not admit of our going into details. We must beg our readers to take our word for it that we have tested the accuracy, so far as we have been able, of a good many of Dr. Jerdon's descriptions and diagnostic characters, and we find they stand the trial extremely well. Much of the book consists of matter the truth of which *ex necessitate* we cannot test, seeing that it embodies the results of the author's personal experience, and we lay no claim to a special knowledge of Indian ornithology. But Dr. Jerdon is obviously an observer so carefully trained that we willingly accept upon trust his statements respecting the habits, the movements, in a word, all that is really meant by the *history* of the birds of India. The greatest fault we have to find with the book (and we

must say we think it amounts to a serious fault) is the unnecessary multiplication of genera. It is perfectly true, as Dr. Jerdon states (Introd. p. xxxiv), that "in practice, and till the whole realm of ornithology is presided over by a master hand, no distinction [between genera and subgenera] can be satisfactorily pointed out, or acted upon." But on this very ground surely it would have been the more simple as well as the more convenient plan not to have acquiesced in the minute subdivisions which it has become the fashion of so many writers now-a-days to make. They cannot fail to be perplexing, if, indeed, they are not actually repugnant, to beginners. In justice, however, to Dr. Jerdon we are bound to say, and we say it with pleasure, that none of the subdivisions we complain of seem to be of his invention.

From what has been said at the beginning of this notice, it will be seen that we regard this work as the foundation of a new edifice to be raised on Indian soil by builders as yet unknown to fame. It can scarcely be seriously doubted, indeed, that its publication will be an effectual incentive to the study of ornithology in that country, and the results cannot fail to be gratifying to all promoters of the science. But from another point of view Dr. Jerdon's arduous labours merit great praise. The friends of the new system whereby the Indian Civil Service is replenished ought to hail our author as a benefactor to those who under it obtain government appointments. What can be worse for a young man, as highly educated as the successful candidates for these much-coveted offices are said to be, than to be banished to a remote post, far from the society of his countrymen, and with no rational employment whatever to occupy his mind after the daily routine of work is finished? He has not the stout bodily constitution, it is alleged, which generally distinguished the uncrammed cadet of the ancient order of things. No wonder then that the "competition-Wallah" succumbs under the enervating influence of a tropical climate, and flies to "brandy-pawnee," or other things worse, as a refuge against the attacks of dull care. Dr. Jerdon has now placed within his reach the means of prosecuting a recreative occupation, healthful alike to mind and body, with the consciousness that in the enjoyment of it he may be able to swell—it matters not to how small an extent—the great and always increasing amount of human knowledge. This fact seems to have been appreciated by the last two enlightened rulers of India, Lords Canning and Elgin, under whose auspices these volumes have been undertaken and elaborated; and we learn with pleasure that the first of them, during his ever-memorable viceroyalty, placed the author "on special duty, with a view to the publication of the present work, thus giving him full leisure to devote to the completion of his researches and to the progress of the book through the press." We regret, however, to hear that of late Dr. Jerdon has been ordered by a subordinate official to return to his professional avocations; and whatever success may attend that gentleman's other measures, we feel sure that this step will prove to be a very short-sighted one, if it prevents the completion of the remaining manuals of the series which

the Surgeon-Major has promised us, merely (from a misguided motive of economy) to save a few rupees to the Indian treasury.

It only remains for us to say that the book, which has been printed in Calcutta, is most creditably got up*, and that we strongly recommend it to our readers.

A Flora of Ulster, and Botanist's Guide to the North of Ireland.

By G. DICKIE, M.D., Prof. of Botany, Aberdeen. 12mo. Belfast, 1864. London: Reeve & Co.

WE little thought, when noticing Mr. Tate's '*Flora Belfastiensis*' in our April Number, to receive so soon another book treating upon the botany of the same part of Ireland, but extending its range considerably further. It might have been well if the authors had each known of the other's intention, as one book would have had more chance of success than two.

Dr. Dickie was resident for some years at Belfast, and then took notes of all the plants of which he ascertained the existence in the north of Ireland, by which he means that part of the island lying to the north of the 54th degree of latitude. In so defining his district we think that he has not been wise. It would have been better to confine himself to Ulster, and include the whole of that; for he has now omitted a small piece of two counties, Monaghan and Cavan. He would then have had a well-defined field in which to work: and if in this field he had divided his localities into groups, according to the three botanical provinces—28. Erne, 29. Donegal, and 30. Ulster Coast (which are laid down in the '*Proceedings of the Dublin University Zoological and Botanical Association*,' i. 246, and the original '*Natural History Review*,' vi. pt. 2. 533)—he would have facilitated the compilation of the much-wanted '*Cybele Hibernica*.' It is true that we may arrange the localities for ourselves, if we think fit so to do; but there are many plants stated to be "frequent," of which it is impossible to learn, from the information given by Dr. Dickie, whether that frequency extends throughout Ulster or is more limited in extent. Certainly we do rather wonder that Dr. Dickie, who has shown the interest which he takes in the geography of plants by his most valuable remarks upon the altitude at which they occur, should have neglected to subdivide his country into districts, both here and in the '*Botanist's Guide to Aberdeen, &c.*,' after the mode which has been found so useful in the more recent English local floras. We consider this a serious omission; and there is another deficiency which forcibly strikes us. Dr. Dickie manifestly takes no interest in what are called "critical" plants. It is the distribution of that class of "species" which we especially desire to learn; and there is nothing in this book to convey information on that subject.

* One clever gentleman of our own craft takes credit to himself for the discovery that Dr. Jerdon has, at page 16 of Volume I., made the mistake of calling the Condor *Sarcorhamphus papa*, and the King-Vulture *S. gryphus*, without acknowledging that this mistake is corrected in the author's own list of "Errata" prefixed to the volume!

But we have done fault-finding, and have much pleasure in praising the book in other respects. The Introduction is a valuable contribution to our knowledge of the range in altitude of Irish plants. We are not aware that any accurate data previously existed on that subject, which the peculiar climate of Ireland renders of more than ordinary interest. It is remarkable that there is a decided fall in the upper limits of some plants in Ireland when compared with those to which they attain in Scotland. Dr. Dickie mentions the following instances :—

Euphrasia officinalis in North-east Scotland attains 3400 feet ; in North-east Ireland, 2400 ; in Mayo, only 1700. The corresponding numbers for *Melampyrum pratense* are 3000, 2200, 1900 ; for *Pinguicula vulgaris*, 2800, 2000, and 800 ; *Orchis maculata*, 3000, 1950, 1800 ; and *Carex binervis*, 3000, 2000, 1800. This is the more remarkable when we remember that the climate is believed to rise in temperature as we proceed from South-east Scotland by Ulster to Mayo. May we attribute the superior range in Scotland to the direct sunlight, of which there certainly is much less in cloudy and rainy Mayo than in Ulster, and especially than in Aberdeenshire?

We have stated our belief that the book is not improved by the addition of an imperfect list of the plants of a small part of northern Mayo, and nearly the whole of Sligo ; for as a Flora of Ulster it may justly claim to be tolerably complete (according to its author's views of species), but as treating of the whole north coast of Ireland it cannot have any such claim. We are far from wishing the western plants to have remained unrecorded ; but it would have been more convenient to have found the list of them placed as an appendix to the Ulster list. There is very much still to be done before we shall know accurately the plants of the far west. Who has examined the wild mountains in the interior of Erris, called the Nephin Beg range ? or who, except the present writer, has botanized in the Mullet ? If these districts have been explored, we know of no published account of the results. Both lie to the north of the 54th degree.

Let us now turn to the species, and place side by side the Floras of Tate and Dickie. We have already remarked that the latter seems to care nothing about critical plants : here, therefore, we at once meet with a marked difference between the books. One example will suffice, and we will take the first. Tate records *Ranunculus peltatus*, *R. Drouetii*, *R. Baudotii*, *R. circinatus*, and *R. hederaceus*. In place of these, Dickie gives for the same district *R. aquatilis*, *R. tripartitus*, and *R. hederaceus*. Here *R. aquatilis* of course includes the first three of Tate's species ; but what has become of *R. circinatus*, which no botanist who has paid any attention to it can doubt being distinct ; and what is *R. tripartitus* ? Surely the latter is not the true plant. The former appears, in Dr. Dickie's Supplement, as a plant about which some doubt may be entertained ; but Mr. Tate and Mr. Stewart have both gathered it. This instance will suffice to show that Tate's Flora is necessary, in addition to Dickie's, if we require complete information of what is known about the plants of Ulster.

MISCELLANEOUS.

On Scientific Nomenclature. By Professor ASA GRAY.

The propositions for the improvement of zoological nomenclature made to the British Association at its twelfth meeting, in 1842, by an influential committee, are well known. They were essentially limited to zoology mainly for the reason, which is undoubtedly true, that botanical nomenclature stands in much less need of distinct enactment than zoological. At the recent Newcastle meeting the committee on this subject was reconstituted, and instructed "to report on the changes which they may consider it desirable to make, if any, in the rules of nomenclature drawn up at the instance of the Association by Mr. Strickland and others, with power to reprint these rules, and to correspond with foreign naturalists and others on the best means of insuring their general adoption." "Accordingly the rules, as originally circulated, are now reprinted, and zoologists are requested to examine them carefully, and to communicate any suggestions for alteration or improvement, on or before the 1st of June, 1864."

As most of the propositions are from their nature equally applicable to botany, and as the new committee comprises the names of four botanists, extremely well selected, it is obvious that the improvement of nomenclature of genera and species in natural history in general is contemplated. We feel free, therefore, to make any suggestions that may occur to us from the botanical point of view.

First, we would recommend that "the admirable code proposed in the 'Philosophica Botanica' of Linnæus"—to which "if zoologists had paid more attention . . . the present attempt at reform would perhaps have been unnecessary"—be reprinted, with indications of the rules which in the lapse of time have become inoperative, or were from the first over-nice (*ex. gr.* 222, 224, 225, 227, 228, 229, 230, &c., most of which are recommendations rather than laws). The British Association's Committee has properly divided its code into two parts, 1. Rules for rectifying the present nomenclature; 2. Recommendations for improving the nomenclature in future. The laws all resolve themselves into, or are consequences of, the fundamental law of priority, "the only effectual and just one."

Proposing here to comment only upon the few propositions which seem to us open to doubt, we venture to suggest that "§ 2. *The binomial nomenclature having originated with Linnæus, the law of priority in respect of that nomenclature is not to extend to the writings of antecedent authors,*" is perhaps somewhat too broadly stated. The essential thing done by Linnæus in the establishment of the binomial nomenclature was, that he added the specific name to the generic. He also reformed genera and generic names; but he did not pretend to be the inventor or establisher of either, at least in botany. This merit he assigns to Tournefort, in words which we have already cited in Silliman's Journal (vol. xxv. p. 134); and he respected accordingly the genera of Tournefort, Plumier, &c., taking only the liberties which fairly pertained to him as a systematic reformer. While, therefore, it is quite out of question to supersede

established Linnæan names by Tournefortian, we think it only right that Tournefortian genera, adopted as such by Linnæus, should continue to be cited as of Tournefort. So, as did Linnæus, we prefer to write *Jasminum*, Tourn., *Circæa*, Tourn., *Rosmarinus*, Tourn., *Tamarindus*, Tourn., &c. Indeed, it is not fair to Linnæus to father upon him generic names, such as the last two and many more, which Linnæus specially objects to, as not made according to rule. Specific names, of course, cannot antedate Linnæus, even if the descriptive phrase of the elders were of a single and fit word.

"§ 10. *A name should be changed which has before been proposed for some other genus in zoology or botany, or for some other species in the same genus, when still retained for such genus or species.*" The first part of this rule is intended, we presume, to be the equivalent of No. 230 of the 'Philosophia Botanica': "*Nomina generica plantarum, cum zoologorum et lithologorum nomenclaturis communia, si a botanicis postea assumpta, ad ipsos remittenda sunt.*" We submit that this rule, however proper in its day, is now inapplicable. Endlicher, who in a few cases endeavoured to apply it, will probably be the last general writer to change generic names in botany because they are established in zoology. It is quite enough if botanists and, perhaps more than can practically be effected, if zoologists will see that the same generic name is used but once in each respective kingdom of nature.

"§ 12. *A name which has never been clearly defined in some published work should be changed for the earliest name by which the object shall have been so defined.*" Very well. And the good of science demands that unpublished descriptions, and manuscript names in collections, however public, should assert no claim as against properly published names. But suppose the author of the latter well knew of the earlier manuscript or unpublished name, and had met with it in public collections, such name being unobjectionable, may he wilfully disregard it? And as to names without characters, may not the affixing of a name to a sufficient specimen in distributed collections (a common way in botany) more surely identify the genus or species than might a brief published description? Now the remarks of the Committee, prefixed to § 12, while they state the legal rule of priority, do not state, or in any way intimate, that a wilful disregard of unpublished names, especially of those in public or distributed collections, is injurious, dishonourable, and morally wrong. In the brotherhood of botanists, it should be added, custom and courtesy and scientific convenience in this respect have the practical force of law, the wilful violation of which would not long be tolerated; and the distribution of named specimens, where and as far as they go, is held to be tantamount to publication.

As to the recommendations for the future improvement of nomenclature, in passing under review the "Classes of objectionable names," we wonder that geographical specific names should have been objected to: we find them very convenient in botany, and, next to characteristic names, about as good as any. Comparative specific names in *oides* and *inea*, &c., are much used by botanists, and are often particularly

characteristic. Specific names derived from persons, used with discretion, and as far as possible restricted to those who have had to do with the species, as discoverer, describer, &c., are surely unobjectionable. Generic names derived from persons are, we agree, best restricted to botany, where, when appropriately applied, they are in good taste, if not too cacophonous. As to closely resembling names, in large genera it may sometimes be best to "call a species *virens* or *virescens*" when there is already a *viridis*. Anagrams, like puns, if not cautiously handled and particularly well made, are intolerable. But what can be prettier, among unmeaning names, than R. Brown's *Tellima*? Botanists will hardly agree that a good generic name which has been effectually superseded by the law of priority should never afterwards be bestowed upon some other genus of some other order. "It has sometimes been the practice, in subdividing an old genus, to give to the lesser genera so formed the names of their respective typical species." The Committee objects to this usage because the promotion calls for new specific names. To us it seems a natural and proper course when the name of the species in question is substantive and otherwise fitting,—most proper when (to take a not uncommon case) one used generically in the first place by ante-Linnean naturalists or herbalists.

But the objection of the Committee is probably connected with a peculiar view which they have adopted as to the way of citing species which have been transferred to some other than the original genus. Here many zoologists, and a few botanists, have been giving themselves much trouble and perplexity, as it seems to us, to little purpose. Take for illustration our Blue Cohosh, originally *Leontice thalictroides* of Linnæus, but afterwards, in Michaux's Flora, taken as the type of a new genus, and therefore appearing as *Caulophyllum thalictroides*. Now if we adopt the view of Linnæus, to which he would probably have adhered had he lived till now, we write the name and the authority thus:—

Leontice thalictroides, Linn.

(Syn. *Caulophyllum thalictroides*, Michx.)

The abbreviated names of the authors appended stand in place of the reference, e. gr. Linn. Sp. Pl. 1, p. 448, and Michx. Fl. Bor.-Am. 1, p. 205, tab. 21. If the other view be adopted, it stands, in fact,

Caulophyllum thalictroides, Michx.

(Syn. *Leontice thalictroides*, Linn.)

But, fearful lest the original describer should be robbed of his due credit, it has been proposed to write,

Caulophyllum thalictroides, Linn.

This is not only an anachronism of half a century, but an imposition upon Linnæus of a view which he had not and perhaps would not have adopted. To avoid such fatal objections, it has been proposed to write *Caulophyllum* (Michx.) *thalictroides*, Linn., which is not only "too lengthy and inconvenient to be used with ease and rapidity," but too cumbrous and uncouth to be used at all. And finally, the Committee propose to write,

Caulophyllum thalictroides (Linn.) (sp.).

which is scarcely shorter, or even to leave out the (sp.). The reader is thus to note that Linnæus originally gave the specific name *thalictroides*, but not the generic. Who did, must be otherwise ascertained. A pretty long experience convinces us that much confusion is risked or trouble expended, and nothing worth while secured by these endeavours to put forward the original rather than the actual application of a specific name. Ante-Linnæan nomenclature broke down in the attempt to combine specific appellation with description. Here the attempt is to connect it with the history of its origin, which, after all, can be rightly told only in the synonymy. The natural remedy for the supposed evil which this mode of citation was to cure is to consider (as is simply the fact) that the appended authority does not indicate the origin, but only the application at the time being, of the particular name; and so no one is thus robbed of his due. The instructed naturalist very well knows the bibliography of species, or where to look for it; the tyro can learn.

"§ C. *Specific names should always be written with a small initial letter, even when derived from persons or places*"—on the ground that proper names written with a capital letter are liable to be mistaken for generic. (But no naturalist would be apt to write the name of a species without that of the genus, or its initial, preceding.) Also, "that all species are *equal*, and should therefore be written all *alike*." The question is one of convenience, taste, and usage. As to the first, we do not think a strong case is made out. If mere uniformity be the leading consideration, it might be well to follow the example of the American author who corrected *Ranunculus Flammula*, Linn., and *R. Cymbalaria*, Pursh, into *R. flammulus* and *R. cymbalarius*! As to taste and usage, we suppose there would be a vast preponderance against the innovation, so far as respects personal names and those substantive names which Linnæus delighted to gather from the old herbalists, &c., and turn to specific use, e. g., *Ranunculus Flammula*, *R. Lingua*, *R. Thora*, *R. Ficaria*, and the like. Adjective names of places and countries Linnæus printed with a small initial, e. g., *R. lapponicus*, &c. DeCandolle writes such names with a capital letter; and this best accords with English analogy, but has not been universally adopted, and probably will not be.

"§ F. *It is recommended that, in subdividing an old genus in future, the names given to the subdivisions should agree in gender with that of the original group.*" The practical objection to this is, that old names should be revived for these genera or subgenera, if there be any applicable ones, which is likely to be the case in botany.—*Silliman's American Journal*, March 1864, p. 278.

On the Roman Imperial and Crested Eagles. By JOHN HOGG, Esq., M.A., F.R.S., F.L.S., &c.*

I purpose in the present paper to make a few brief remarks on the *Crested* or *Crowned* Eagles, and the usual *Roman Eagle*.

This last bird, which is generally termed the *Imperial Eagle*, is

* This paper was read to the *Section D* of the British Association at Newcastle-on-Tyne, on August 28, 1863.

represented with its head *plain*, that is to say, *not* crested; it is in appearance the same as the attendant bird of the "King of Gods and Men," and is generally represented as standing at the foot of his throne, or sometimes as the bearer of his thunder and lightning. Indeed he also often appears perched on the top of his sceptre. He is always considered as the attribute or emblem of "Father Jove."

So likewise the same noble bird is the attendant on Jupiter's cup-bearer, Ganymedes; for, according to the well-known fable, that great god sent his eagle to carry off the youth Ganymedes in his claws from earth to the celestial regions.

A good copy of this bird of Jupiter, called by Virgil and Ovid "*Jovis armiger*," from an antique group, representing the *Eagle* and *Ganymedes*, may be seen in Bell's '*Pantheon*,' vol. i. Also "a small bronze eagle, the ensign of a Roman legion," is given in Duppa's '*Travels*' (in Sicily, &c., 2nd edition, 1829), tab. 4. That traveller states that the original bronze figure is preserved in the museum of the "Convent of St. Nicholas (d'Arena) at Catania." This convent is now called "*Convento di S. Benedetto*," according to Mr. G. Dennis, in his '*Handbook of Sicily*,' published by Murray: at p. 399, he thus mentions this ensign as "*a Roman Legionary Eagle* in excellent preservation." From the second century before Christ, the *Eagle* is said to have become the *sole* military ensign; and it was mostly *small* in size, because Florus (lib. iv. cap. 12) relates that an ensign-bearer, in the wars of Julius Cæsar, in order to prevent the enemy from taking it, pulled off the eagle from the top of the gilt pole, and hid it, by placing it under cover of his belt:—"terciam (*aquilam*) signifer prius, quam in manus hostium veniret, evulsit; mersamque intra baltei sui latebras gerens, in cruenta palude sic latuit."

In later times, the *eagle* was borne with the *legion*, which, indeed, occasionally took its name, "*Aquila*."

This *Eagle*, which was also adopted by the Roman emperors for their imperial symbol, is considered to be the *Aquila heliaca* of Savigny, which greatly resembles our Golden Eagle (*A. chrysaetos*) in plumage, though of a darker brown. It inhabits North Africa and Palestine, and is but rarely found in Europe. A living specimen may now be seen in the Zoological Gardens, in Regent's Park.

Next as regards the *Crested Eagles*.

Being lately engaged on a memoir on Baalbec, the ancient Heliopolis, or "Sun City" of Syria, I was desirous, if possible, of ascertaining whether the Crested Eagle, which is well sculptured on the soffit of a door in the Temple of Apollo or the Sun, could be accounted a *real* species, or only an *imaginary* one carved after a fancied design of the sculptor. The bird is engraven in Pococke's '*Description of the East*' (vol. ii. plate 16), and is described as 2½ feet in height, and 11 feet in extent from the tips of the outspread wings. The same sculptured bird is also given, on a somewhat larger scale in plate 34 of Wood's '*Baalbec*.' Moreover, on the soffit of the door of the cella of the Temple of the Sun,

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at Palmyra, in Syria, a *like Eagle* is sculptured. (See fig. H. in plate 18 of Wood's 'Palmyra'.)

In my work on Baalbec, I have stated, "in both" the sculptures at Baalbec and Palmyra "the Eagles differ from that represented as the attendant bird of Jupiter, by bearing a *crest*, which may possibly allude to the radiated orb or *rays* of the sun." (Trans. Roy. Soc. of Literature, vol. vii. p. 300.)

I will now point out four or five Eagles having a *crest* or crown, and from one or two of which the sculptured birds at Baalbec and Palmyra may have been designed by the Roman artists.

Upon the whole, the species which seems to agree well with the sculptures is the *Aquila Desmursii*. This fine bird is well drawn and beautifully coloured in tab. 77 of vol. iv. 'Trans. Zool. Society;' but in Hartlaub's work on the Ornithology of West Africa, it is incorrectly written *Desmuri* (of Jules Verreaux). It occurs at Bissao, in Western Africa, and is called by the natives *Socolas*; it is also met with in Abyssinia and Nubia, and along the banks of the White River (Bahr el Abiad). Dr. Hartlaub, however, makes no mention of its *crest*. It is much like both *A. pennata* and *A. navia*. It is subject to many changes in its plumage at various ages, although its usual plumage presents a rich chocolate-colour; its tail and the extremities of its wings are black. A well-marked "distinction," Mr. Gurney says, "in *Aquila Desmursii* is a well-defined though small *occipital crest*, consisting of from eight to nine pointed feathers, the longest of which are fully an inch and a half in length" (p. 365, vol. iv. Trans. Zool. Society).

This bird especially resembles Wood's representation of the Eagle at Palmyra, both in the size and form of the *crest*; but it differs from it in having the *tarsi hairy* to the toes. Being an inhabitant of parts of Africa, in particular of the west coast, we may reasonably conclude that the Romans might have been acquainted with it.

Another noble *Crested Eagle* is given in the woodcut published in the 'Field' newspaper, on May 23, 1863. It has recently been brought to this country; and I visited the living specimen in June, last year, at the Zoological Gardens in the Regent's Park, where it had then been about four months; I have also seen the stuffed specimen in the British Museum. It was named *Harpyhaliaetus coronatus* by Temminck, and appeared to be shy. The general colour of its plumage is a lead-coloured grey, and its fine *long crest*, of a dark grey, becomes nearly black at the end. In this character it agrees with the two sculptured Eagles, and likewise in its legs or *tarsi* being *bare* to the toes. In both of these characters it might answer to the sculptured figures at Baalbec and Palmyra; but being a native of the New World, in Brazil and Paraguay, we cannot suppose that it could have formed the model for the sculptors or architects of these superb temples, which were erected during the Roman Empire.

I further noticed a more powerful Eagle among the stuffed birds in the British Museum, which bore a *larger* and more developed *crest*; but, as it inhabits "South America and British Guiana," it cannot, for the reason which I have just stated, be referred to

the sculptured Eagles. It is called *Thrasaëtus harpyia*, or "Crested Eagle."

Either one of the two following species, also preserved in the collection of the British Museum, is not unlikely to have presented the type of a *Crested* Eagle to those sculptors, namely, *first*, *Spizaëtus cirrhatus*, or the "Crested Indian Eagle," with its legs feathered to the toes; inhabiting Nepal and India, it might have been known to the Romans.

And the *second* species, *Spizaëtus coronatus*, is a truly fine bird, bearing a large and long *crest*: it is found in Southern Africa. Although this, like the preceding species, has its *tarsi feathered*, still this character, being very difficult for the sculptor to represent in stone, may have been purposely omitted.

I may then add, in concluding, that either this last-named "Crowned Eagle" (*S. coronatus*) or the *A. Desmursii* may have been the representative of the Palmyra and Baalbec Eagles; for I can by no means think that the sculptors executed those admirably finished *Crested* Eagles in the splendid Temples of the Sun in both of those cities, from their own imagination, and without the aid of an existing *natural species* to direct them in their measurements of the stone figures, and more especially since that sun-bird was the *sacred symbol* of the Great Deity in those cities, where the chief worship of *Baal*, or *Apollo*, or the *Sun* had for so many ages prevailed, and even become renowned throughout the Roman world.

Climbing Habits of the Anabas scandens.

To the Editors of the Annals of Natural History.

GENTLEMEN,—The February Number of the 'Annals of Natural History' contained an article on the climbing habits of the *Anabas scandens*, written by Capt. Mitchell, of the Madras Government Central Museum; and the following extract from a private letter just received from him may be of interest to your readers as tending to confirm the views stated in the paper referred to.

Captain Mitchell says in his letter:—

"Rungasawmy brought to the library, two days ago, three live specimens of the *Anabas scandens*, to show me how it progressed. It was really most amusing to see these creatures scudding along the rattan mat. The great motive agent was evidently the operculum, which they opened and shut with great rapidity, moving first on one side and then on the other. The pectoral fin appeared also to be used; but I could not see that the tail was of much assistance. So long as the direction of movement was across the rattans, progress seemed tolerably easy; but one fellow got on the line of the rattans, and seemed much bothered until he changed his direction by a 'right shoulders forward.' I have the three fish in my aquarium, where they seem quite at home. They do not appear to breathe like other fish: I have watched one for some minutes without perceiving any motion of the lips or operculum."

Your very obedient Servant,

London, May 13, 1864.

A. C. BRISBANE NEILL.

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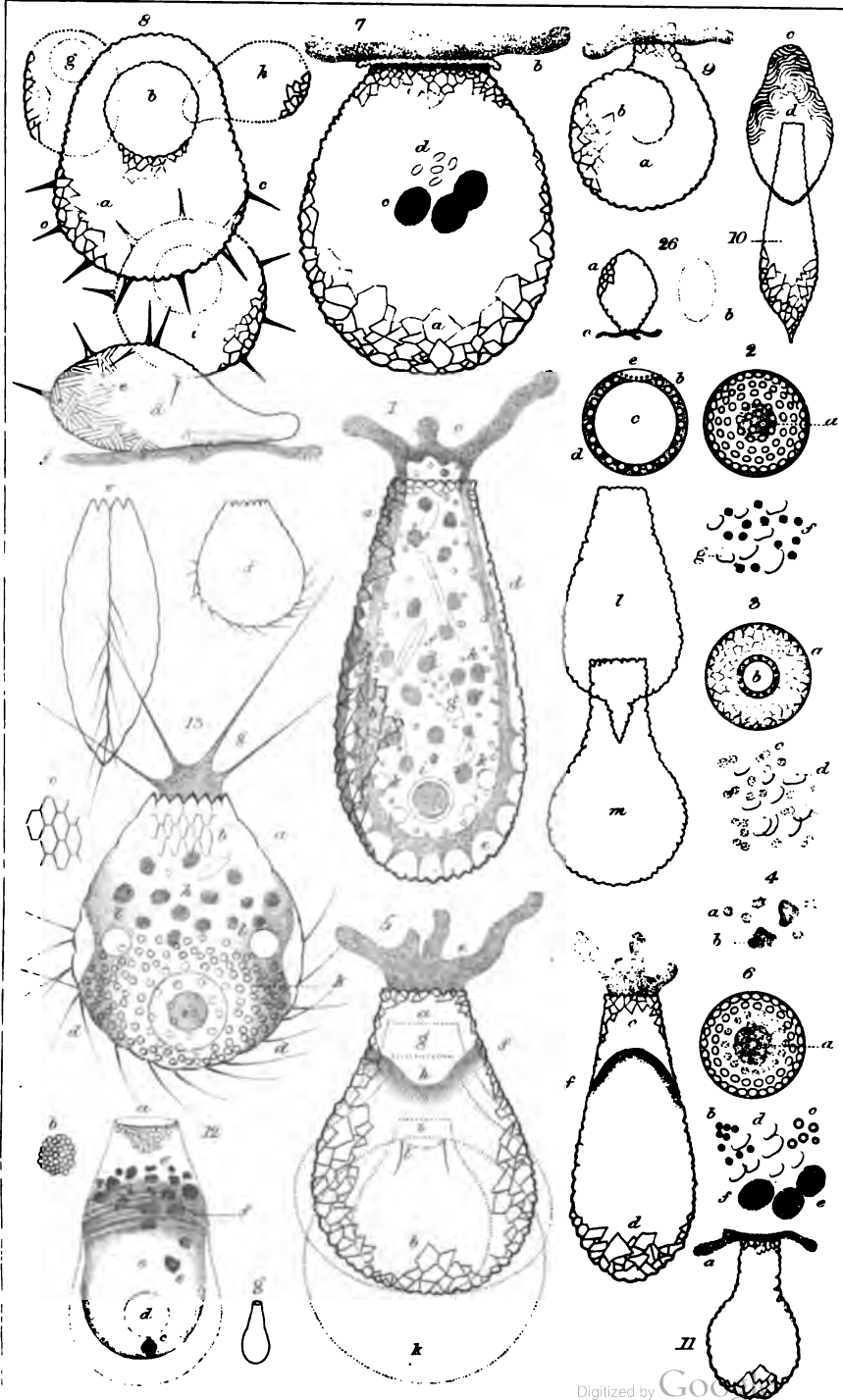
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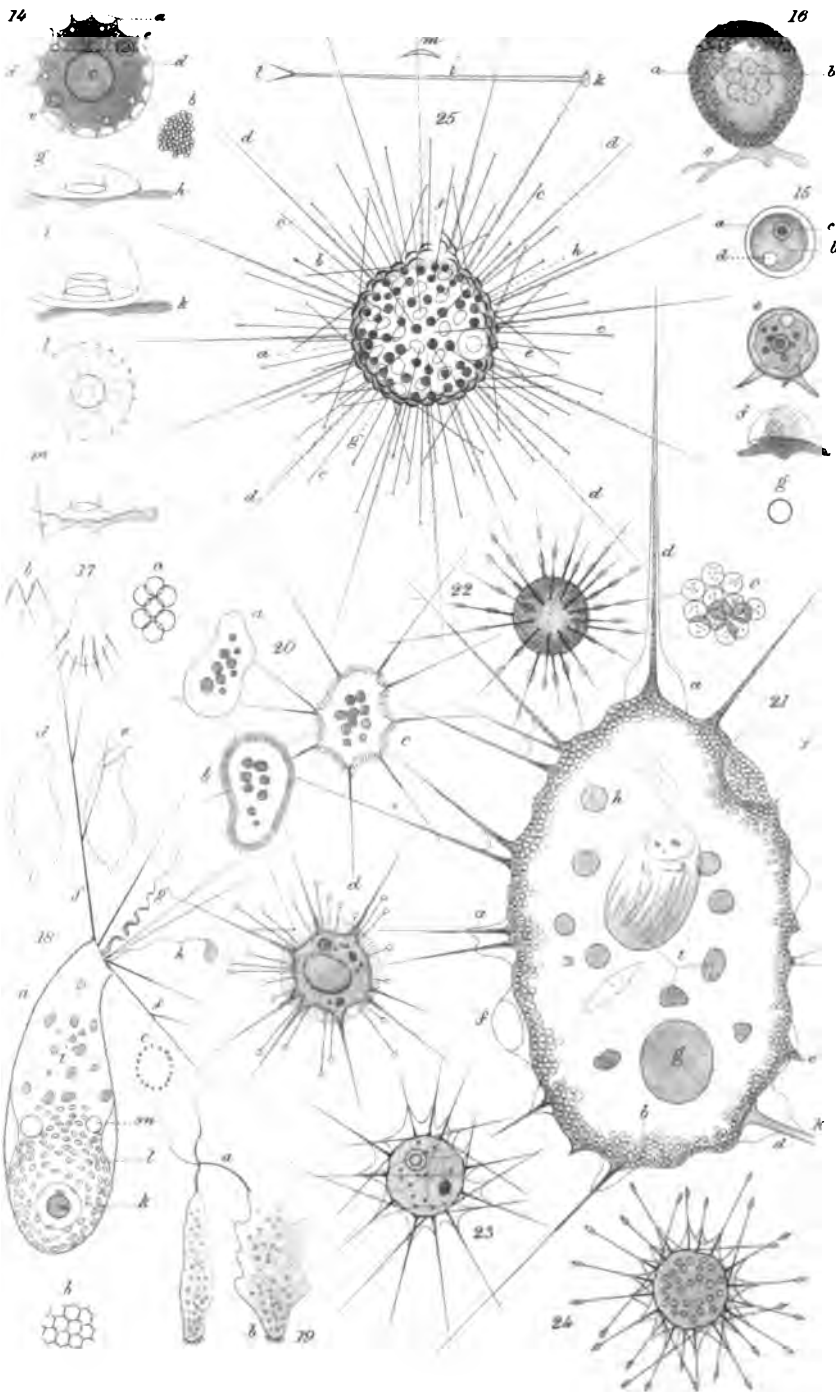
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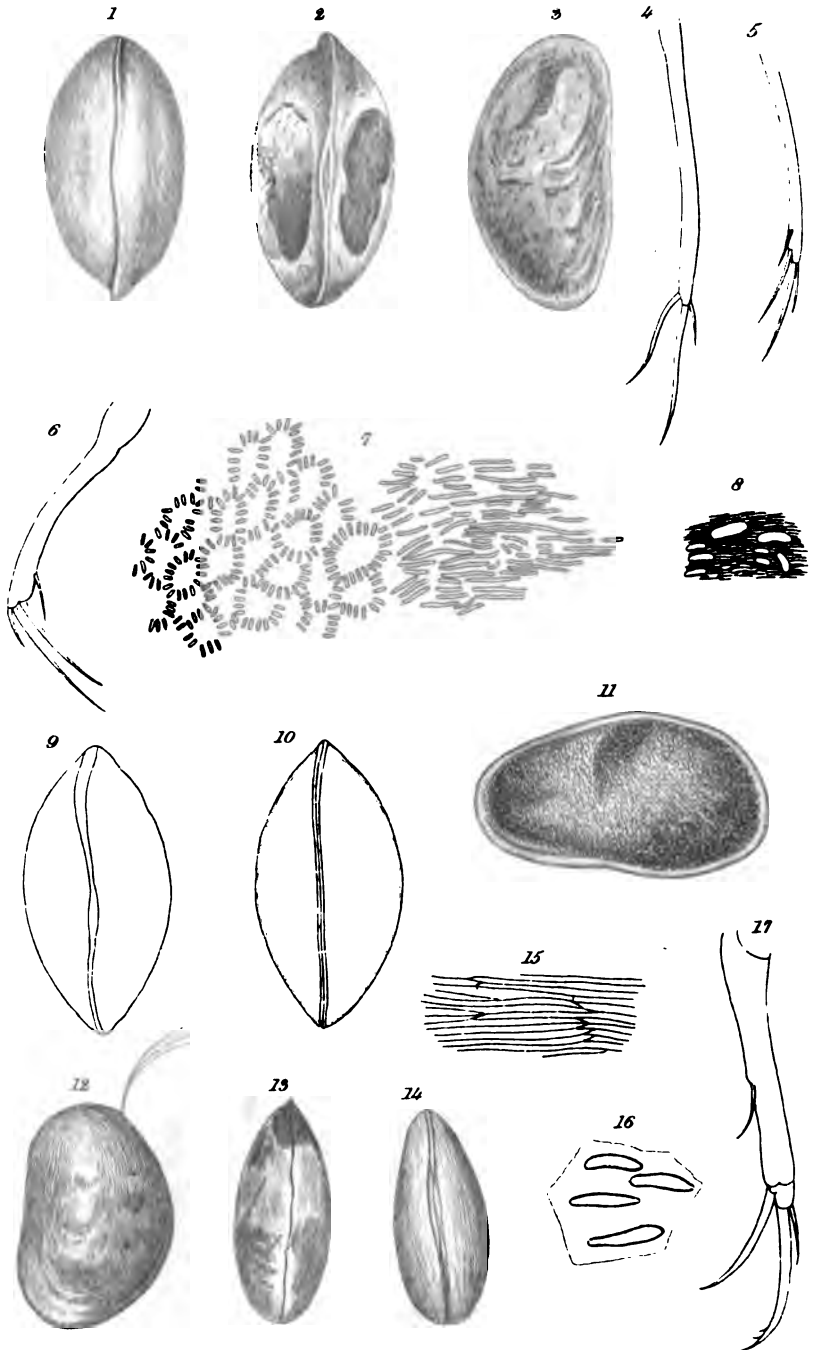


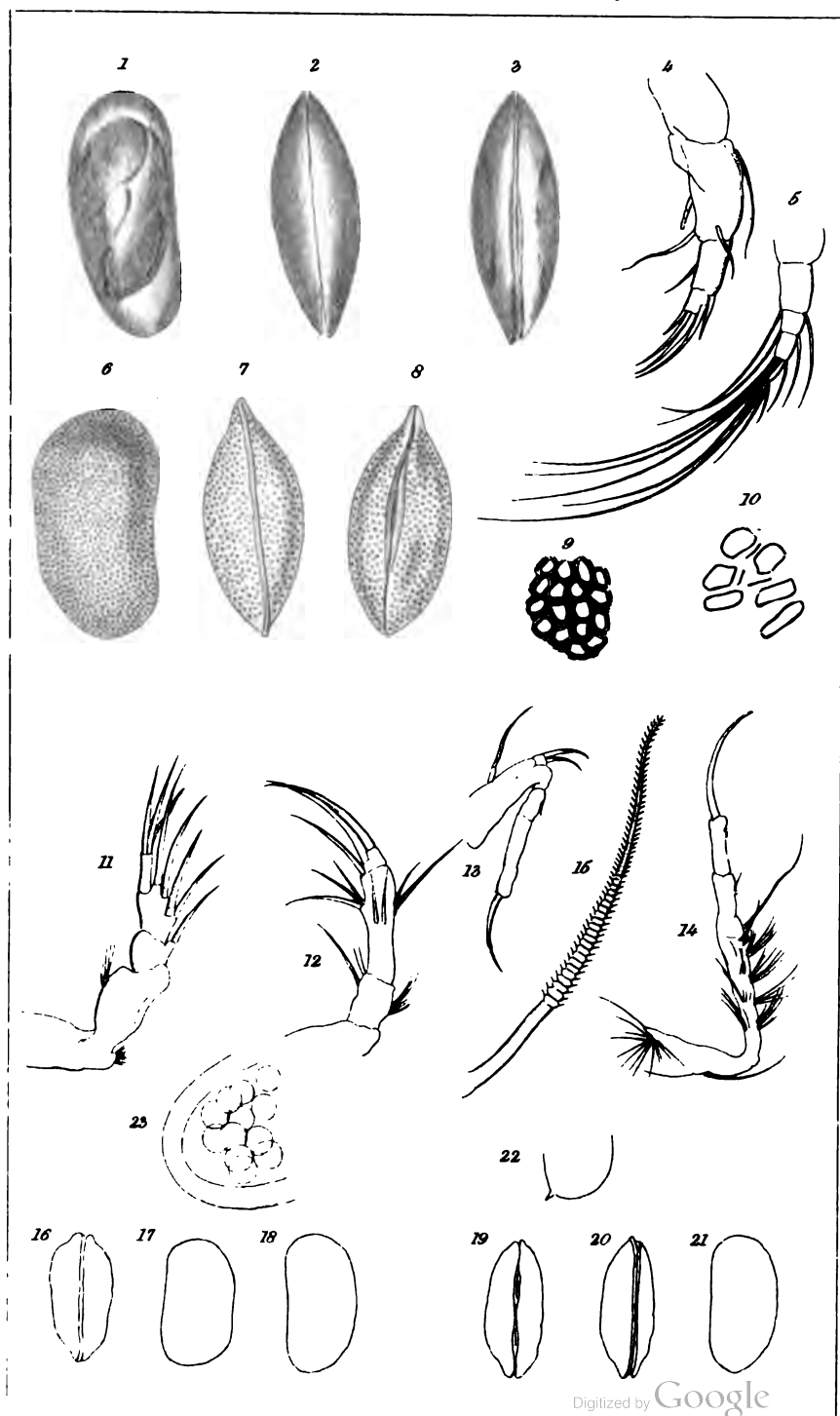


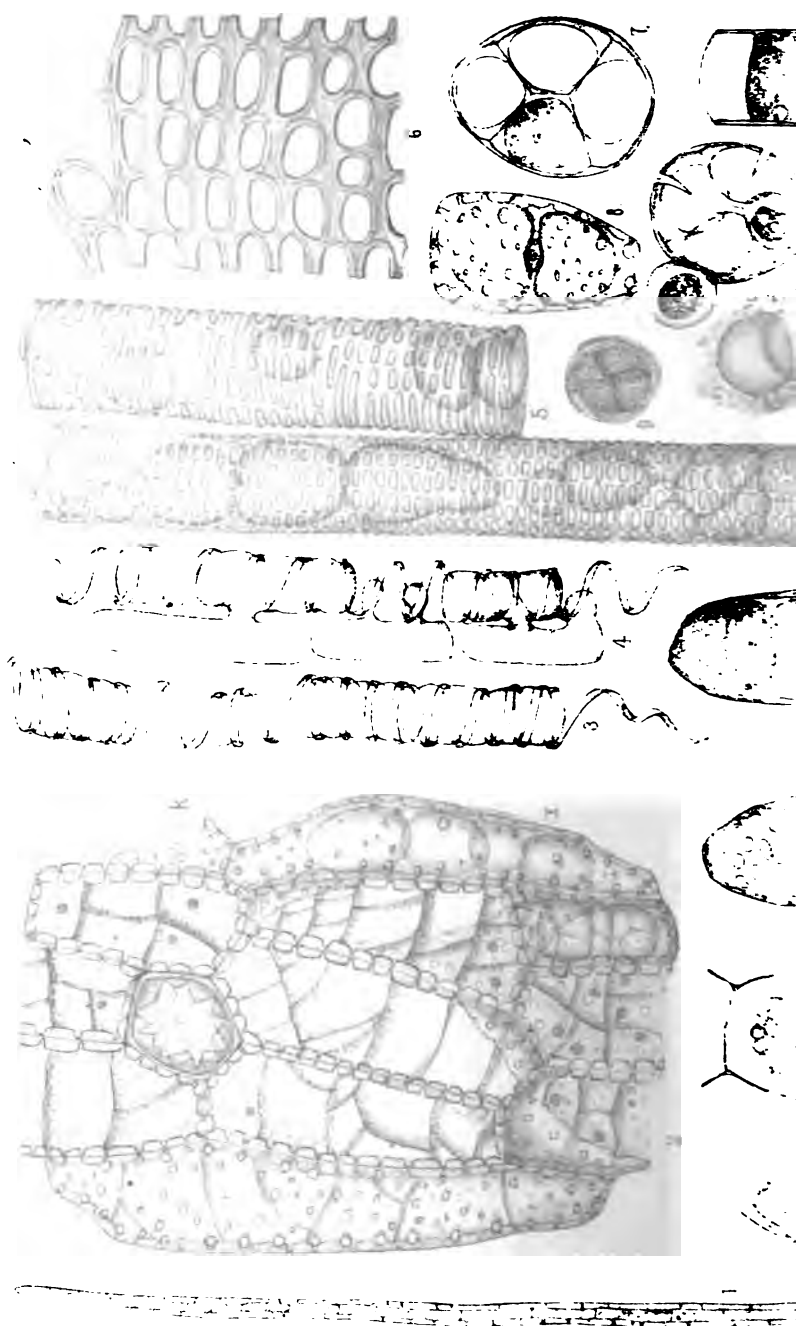
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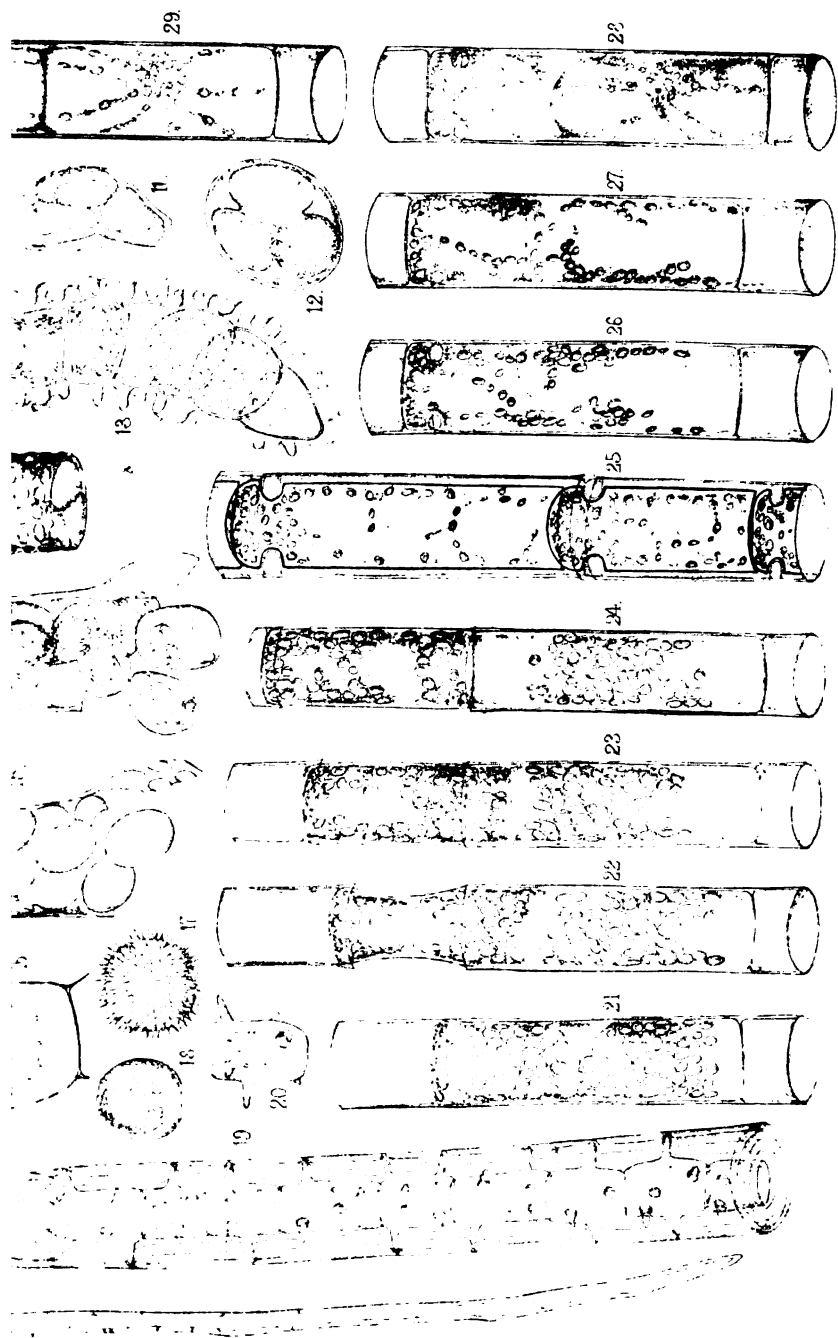
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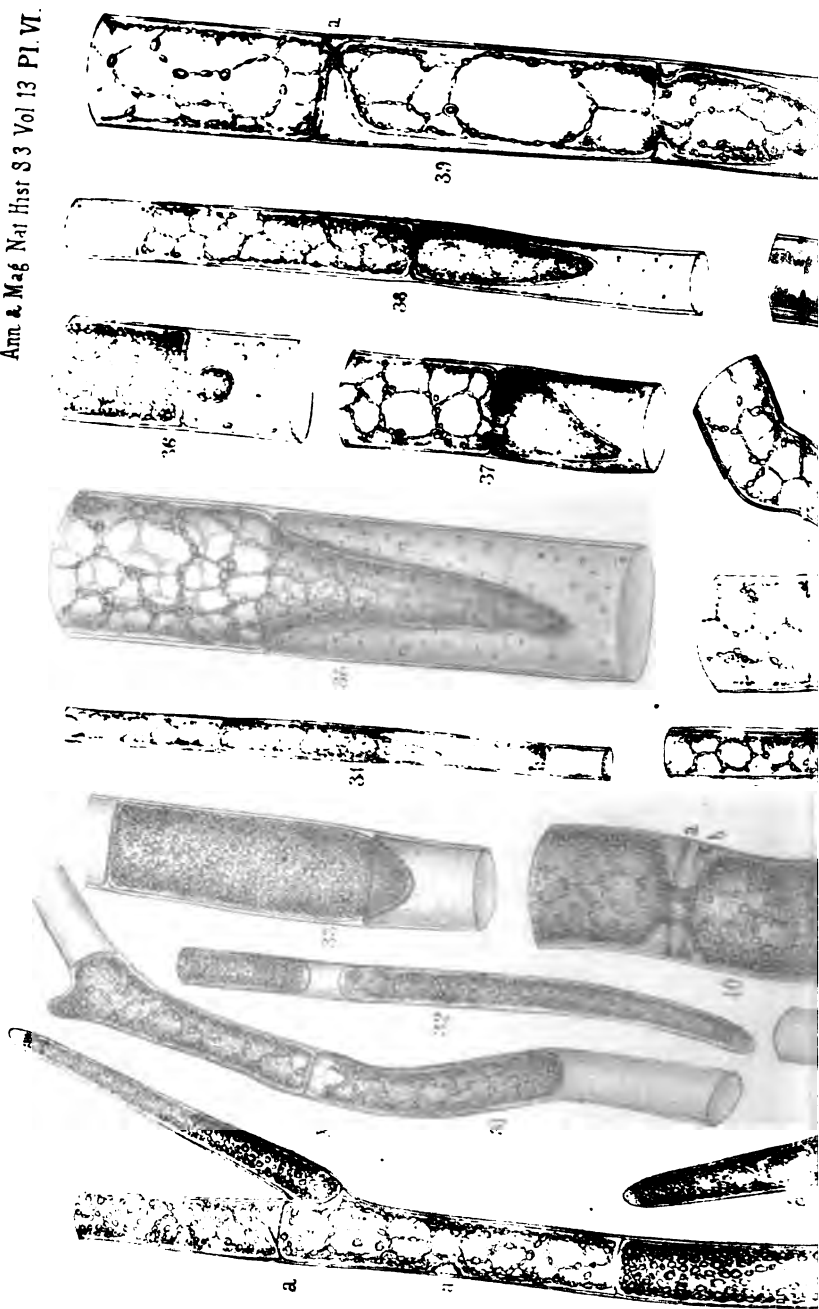


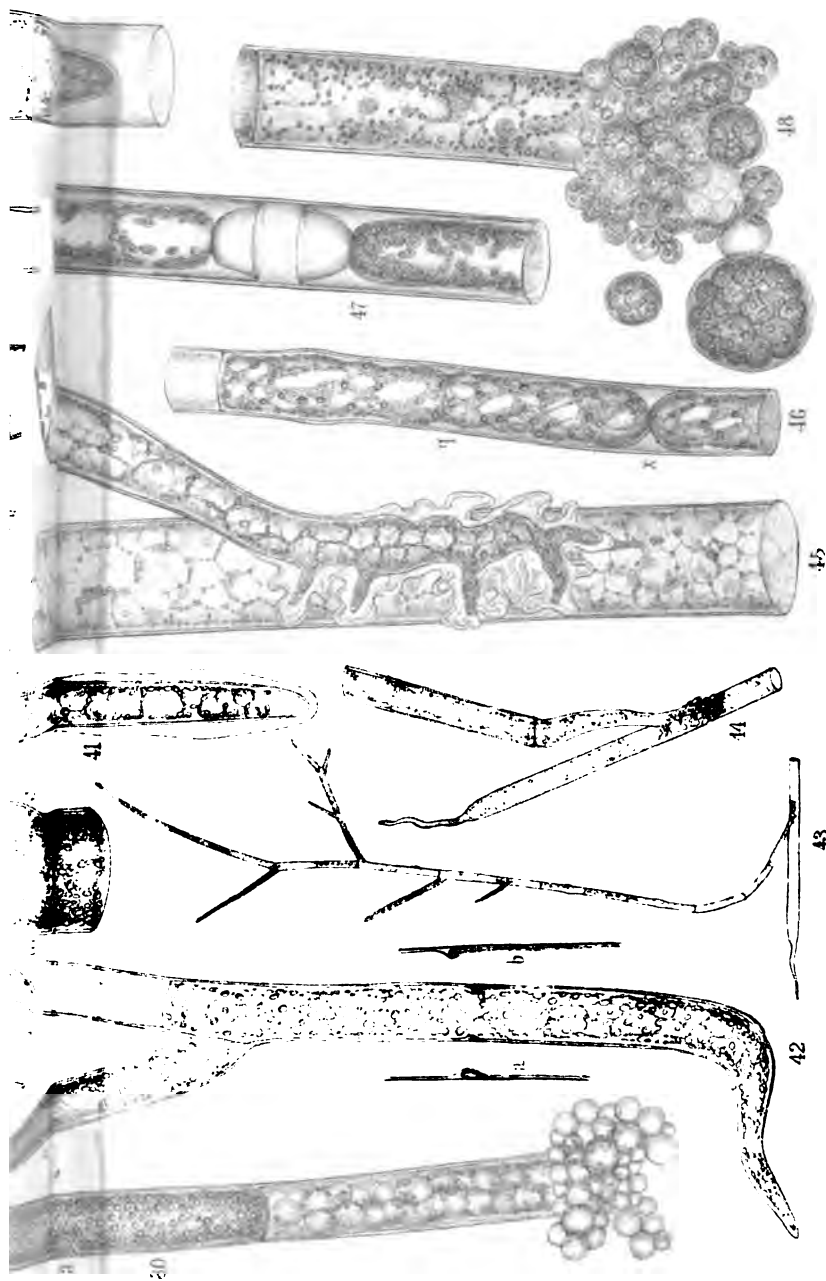






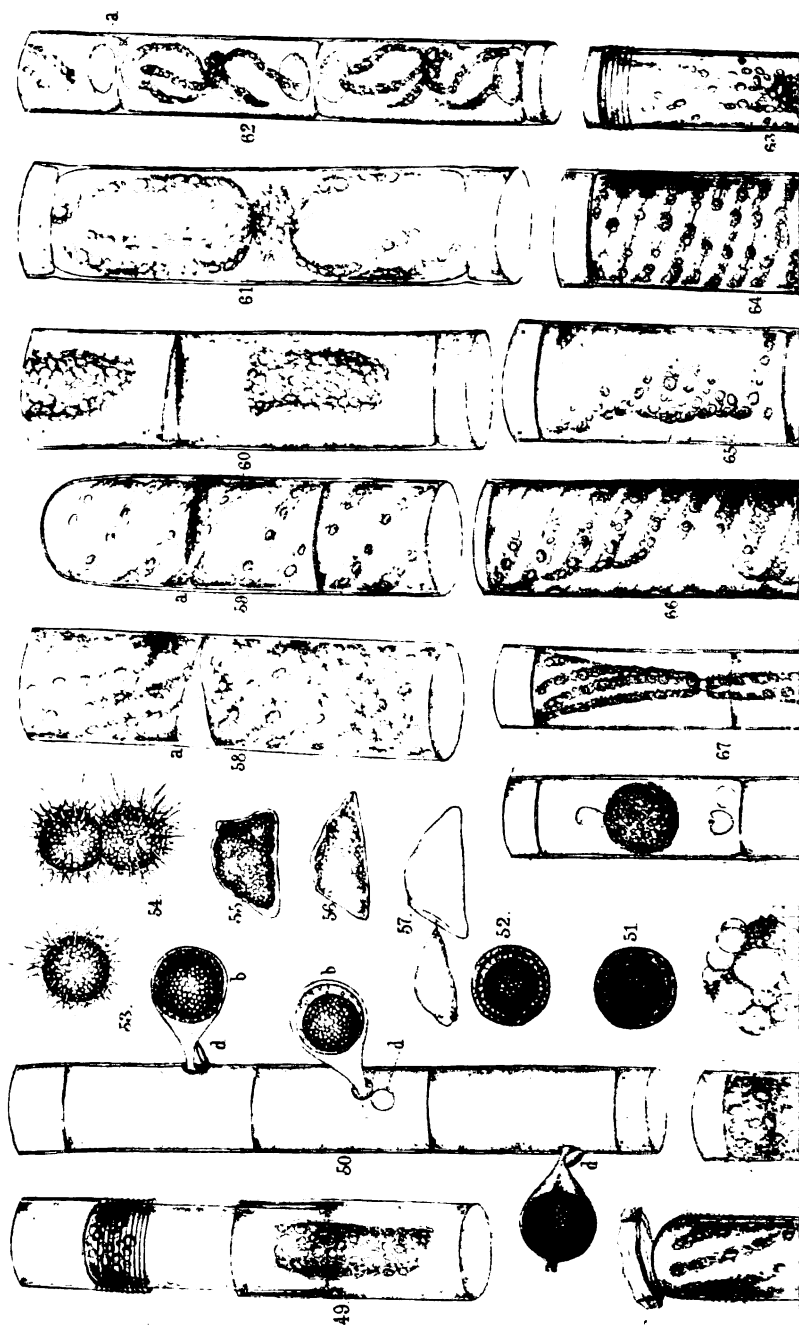




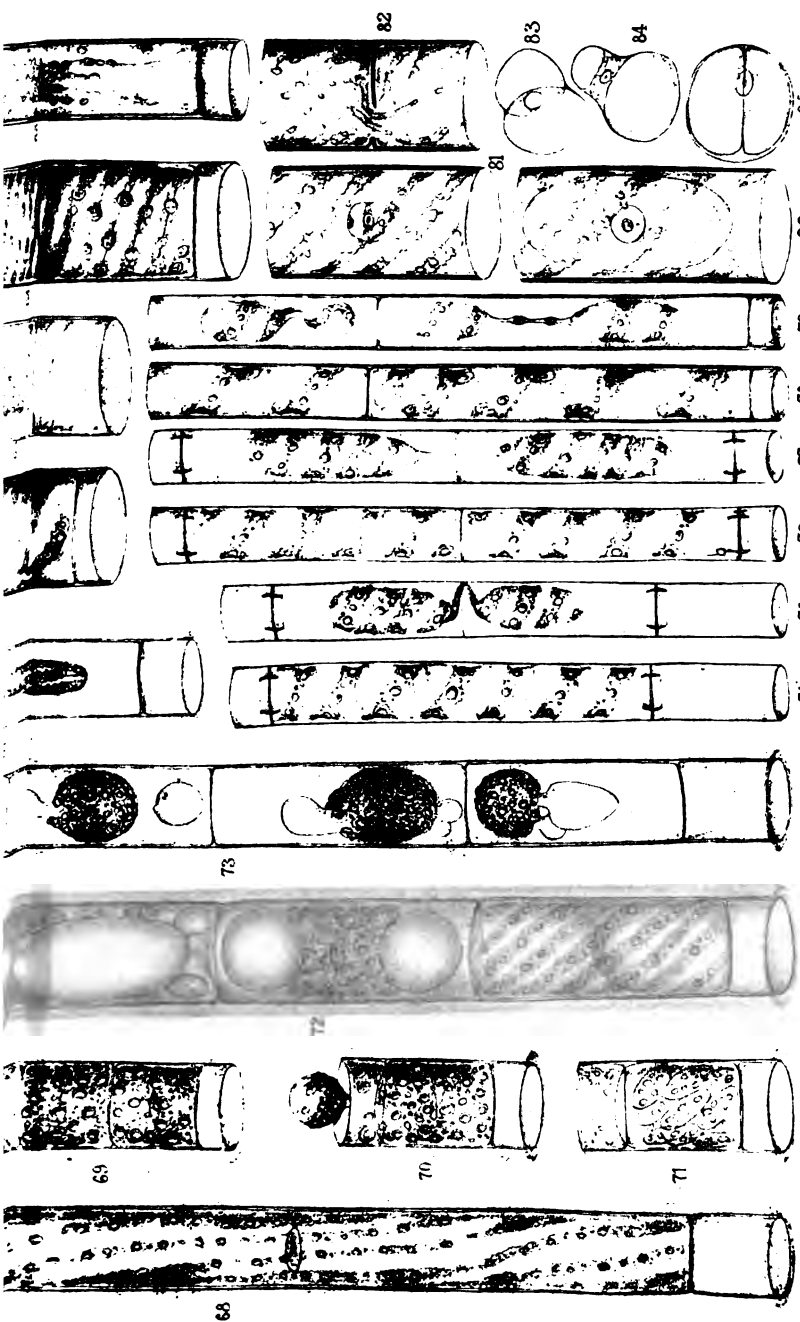


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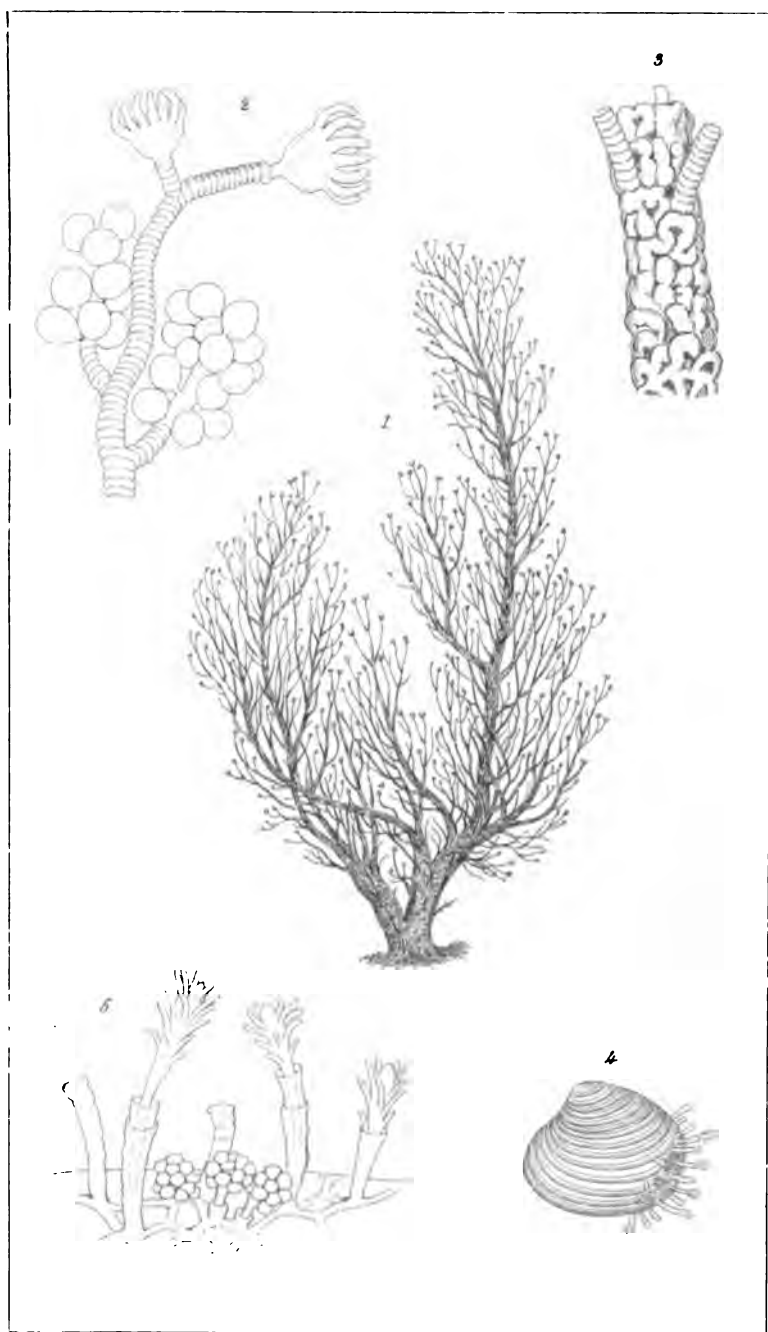
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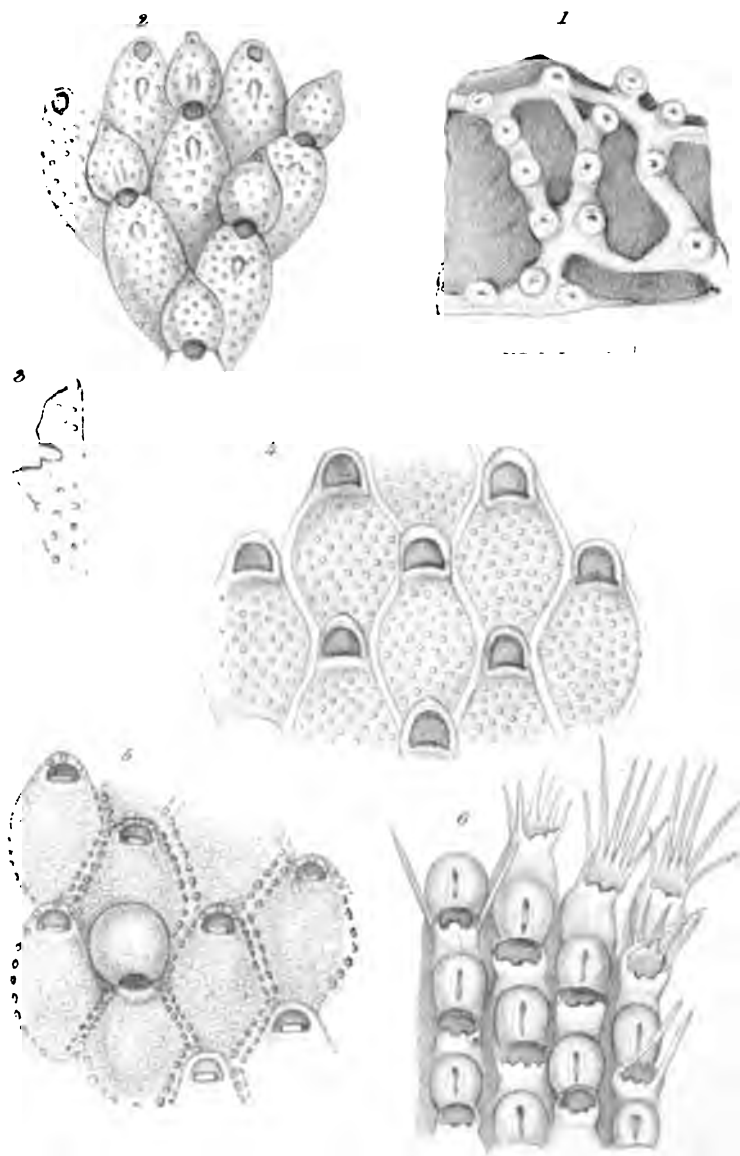


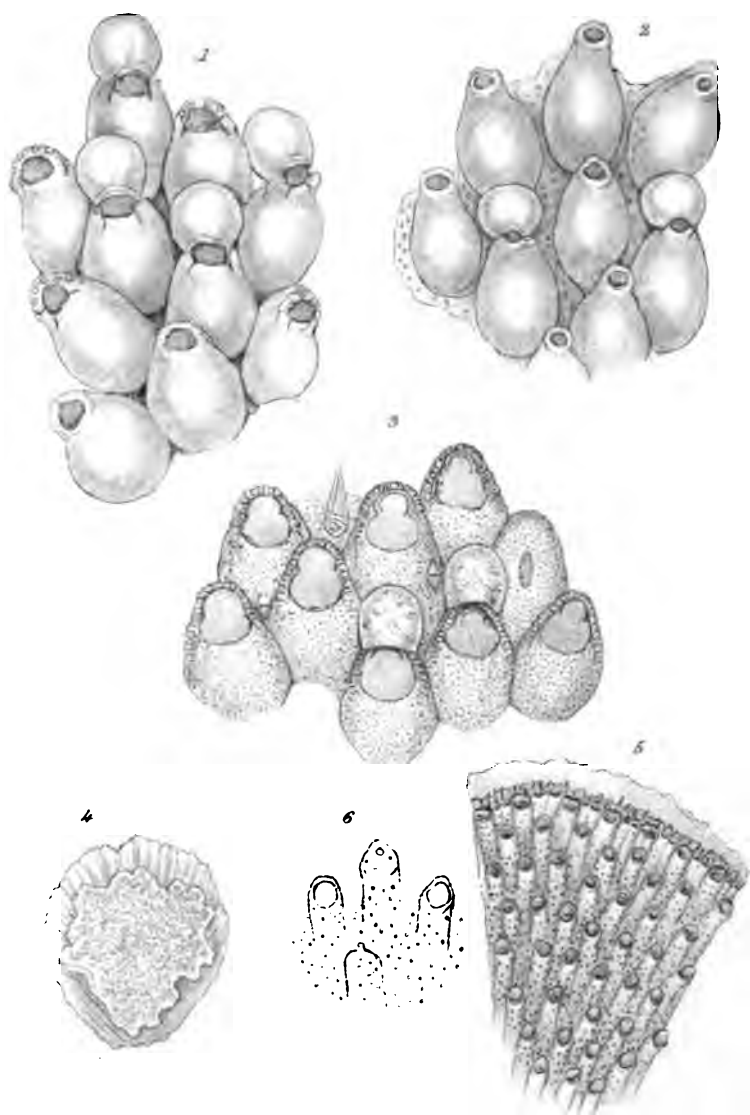
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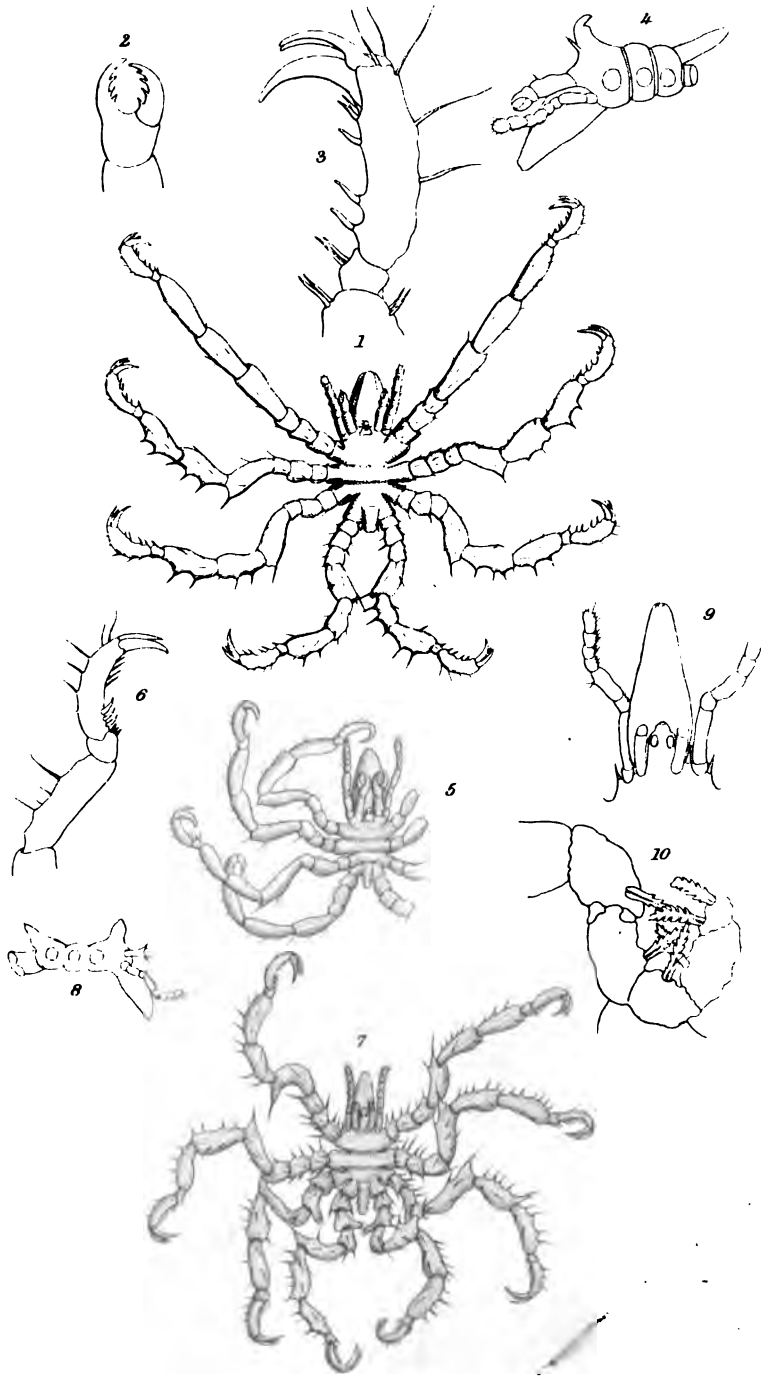


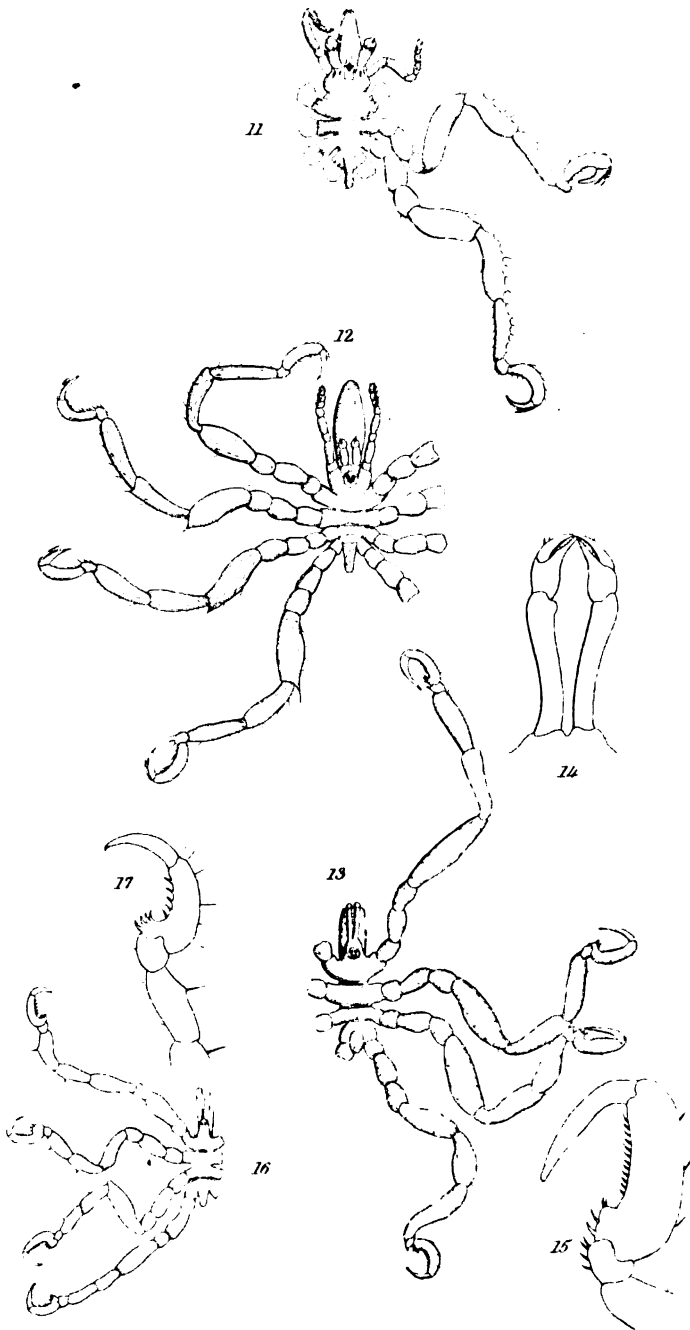


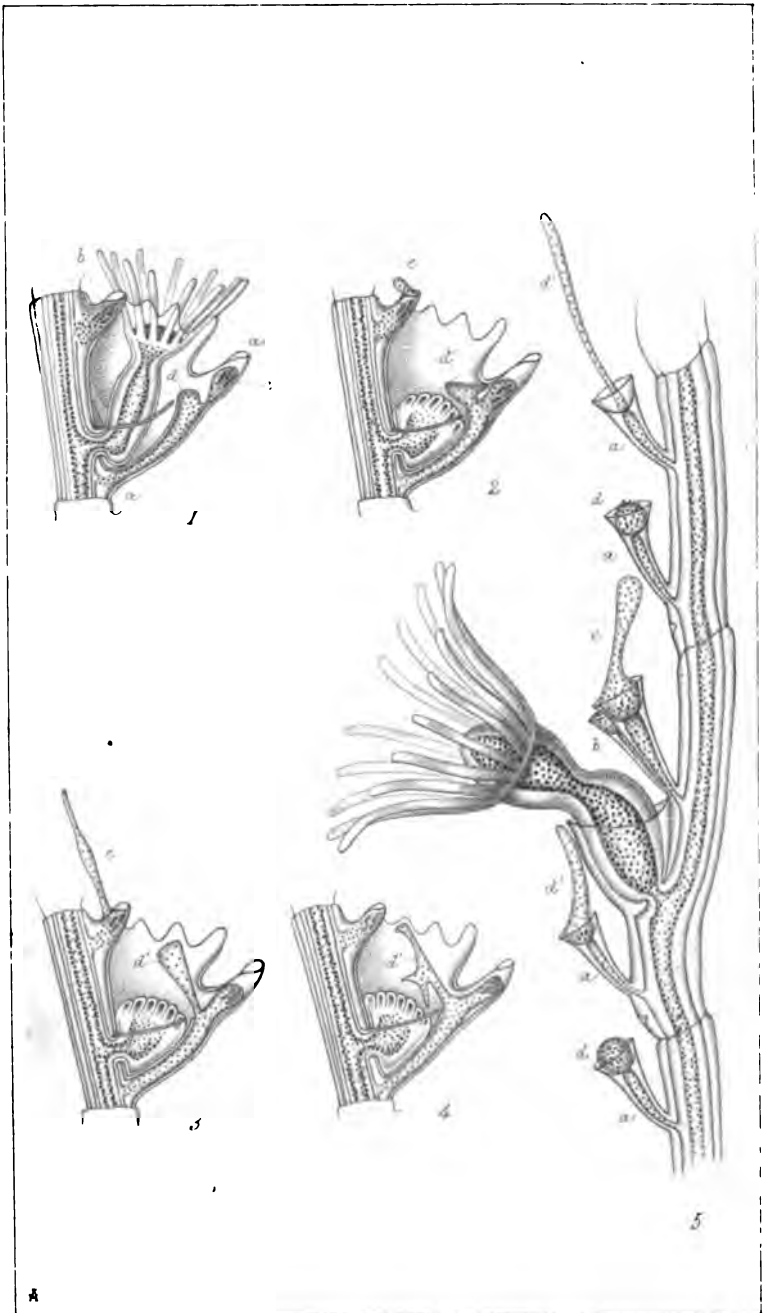


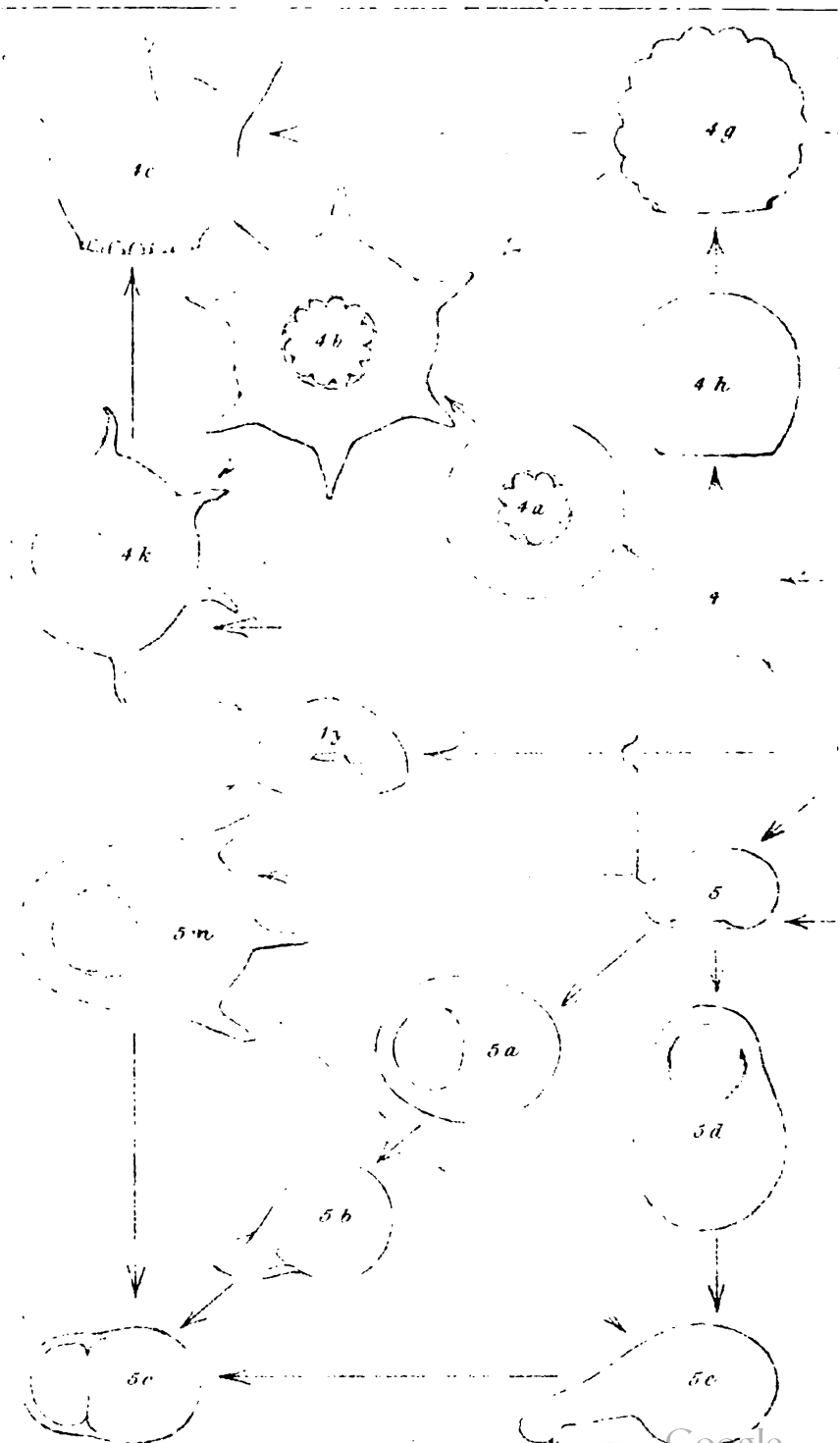


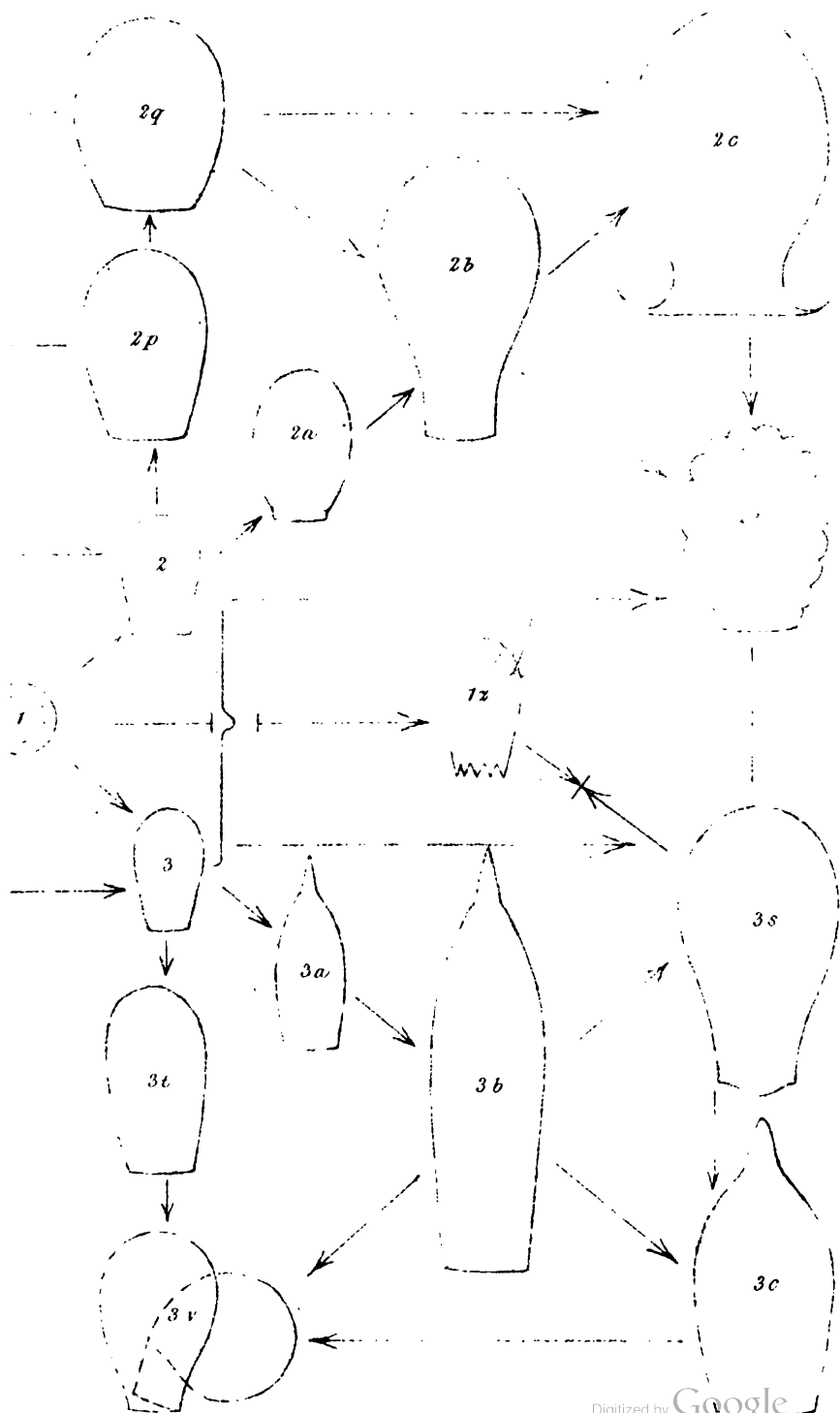


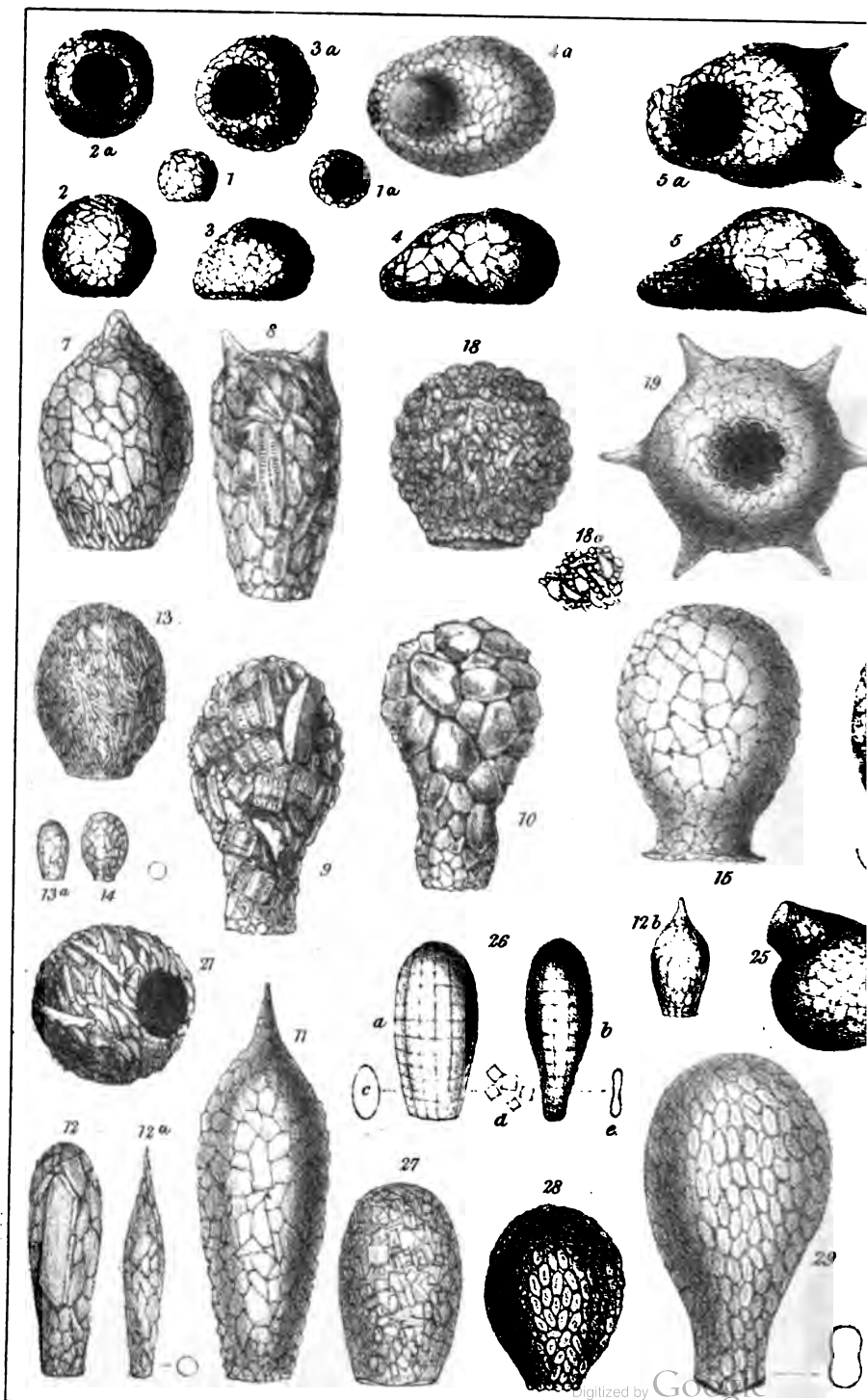


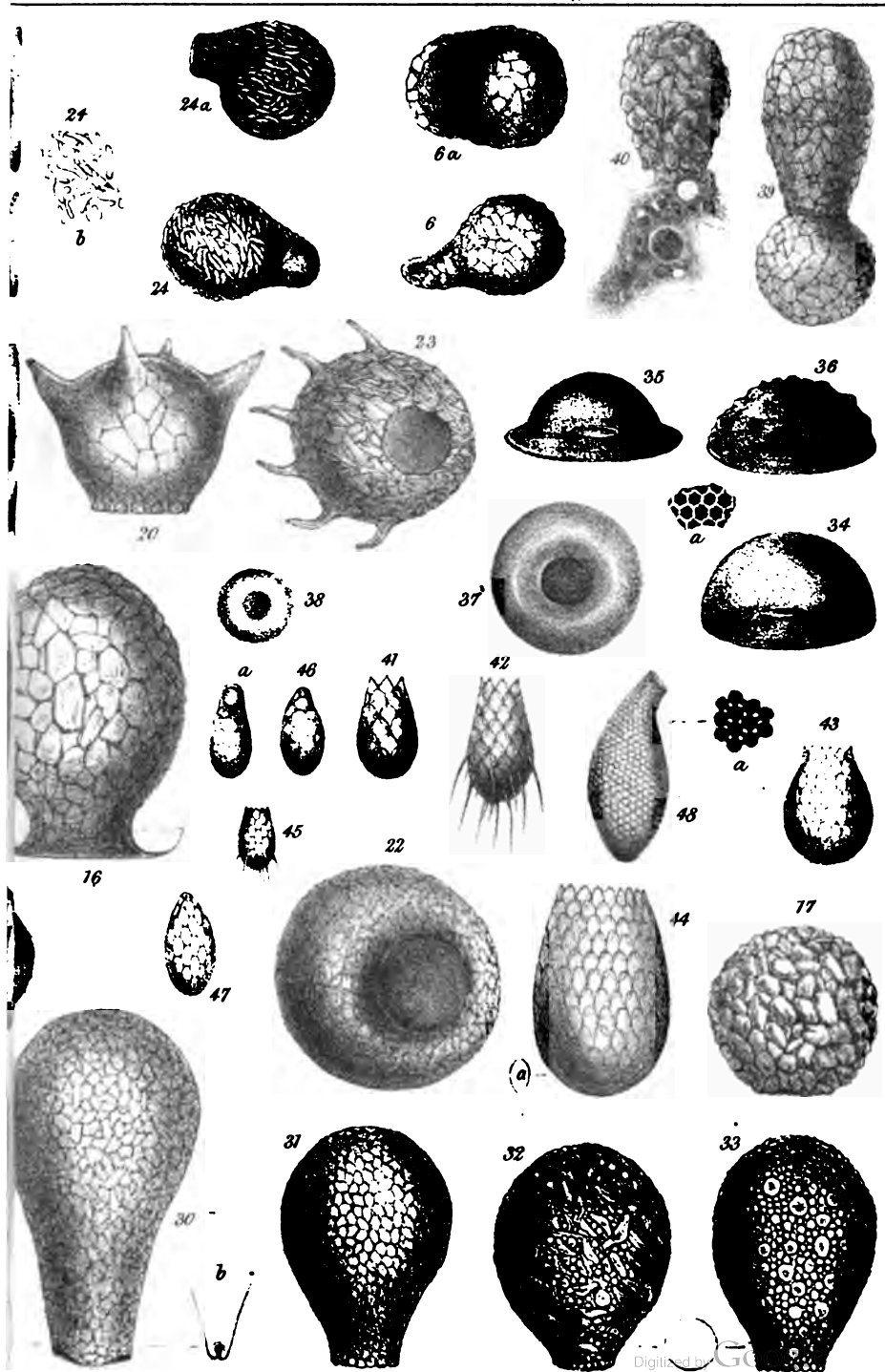


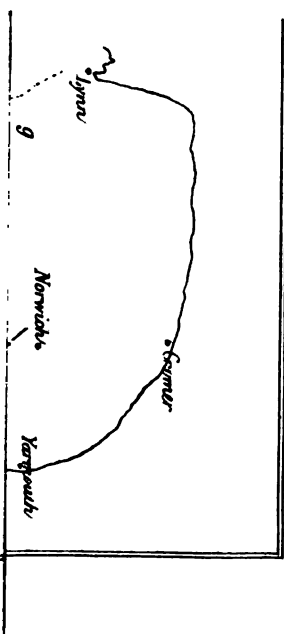










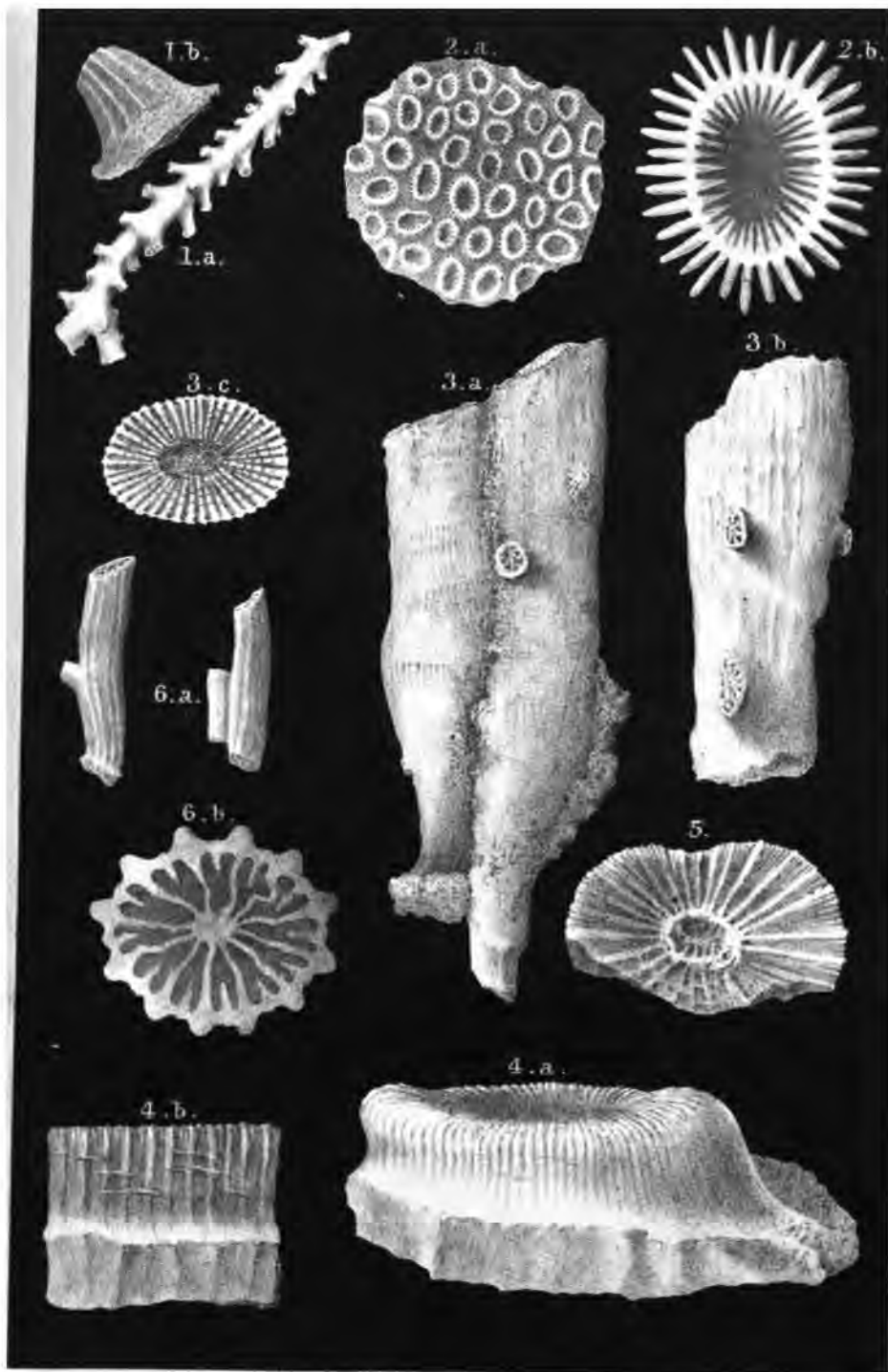


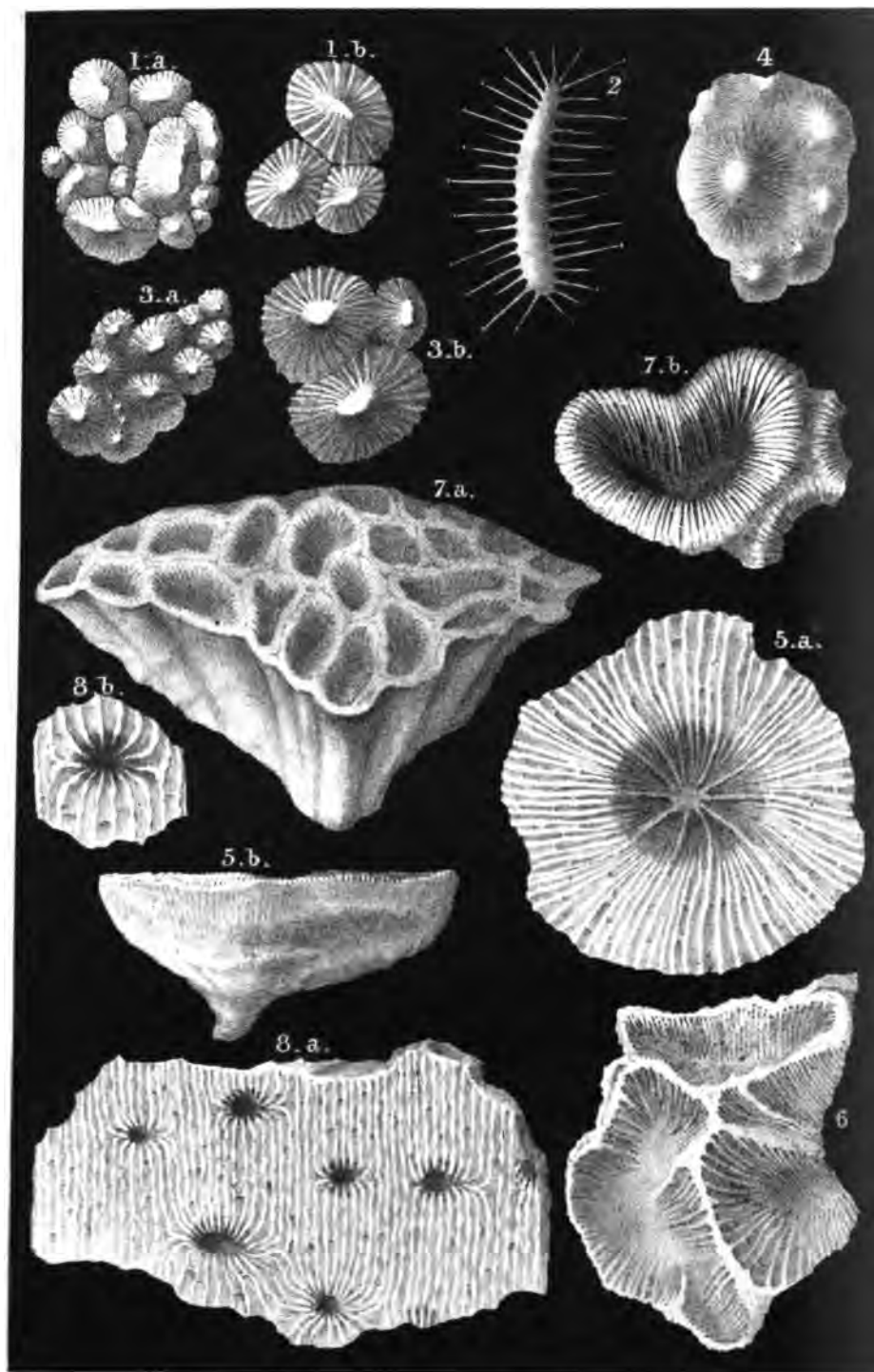
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